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Blue Innovation and Blue Economy - The Portuguese Case Study

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Master's in Management

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BUSINESS
SCHOOL

Department of Marketing, Operations and General Management

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Para a Edite Nina

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Resumo

Num mundo em crise devido às mudanças climáticas e com os seus efeitos sobre milhões de pessoas, as empresas devem focar-se em inovações sustentáveis. A inovação sustentável é o barco salva-vidas em que as empresas devem confiar. A Economia Azul é um tópico bastante recente que é composto por um conjunto de indústrias relacionadas com o mar que visam desenvolver a sustentabilidade, ao mesmo tempo que desenvolvem o crescimento económico. O Mundo analisa este novo assunto com a esperança de que possa liderar a batalha contra as alterações climáticas.

Esta pesquisa tem como objectivo identificar as inovações desenvolvidas por empresas portuguesas na Economia Azul e como essas inovações contribuem para o desenvolvimento da indústria. A metodologia de análise desta dissertação assenta num estudo qualitativo suportado em entrevistas dirigidas a uma amostra de 7 empresas que integram o Cluster Português do Mar. Os resultados obtidos permitem concluir que apesar de ainda haver um longo caminho a percorrer, as empresas portuguesas estão empenhadas no desenvolvimento sustentável das suas indústrias através de inovações sustentáveis. Estas acreditam que com o devido apoio do governo, esse futuro será alcançado.

Palavras-Chave: Sustentabilidade; Inovação; Empresas Portuguesas; Economia Azul

Abstract

In a world at a breaking point due to the climate changes and its effects on millions of people, companies must focus on sustainable innovations. Sustainable innovation is the lifeguard boat that the companies need to rely on. Blue Economy is a quite recent subject that is composed by a series of industries related to the sea that aims to develop sustainability, while developing economic growth. The world is looking to this new subject with the hope it can lead the battle against climate changes.

This research's objective is to identify innovations being developed by Portuguese companies in the Blue Economy and how they contribute to the development of the industry. The analysis methodology is based on a qualitative study supported by interviews directed to a sample of 7 companies that are part of the Portuguese Cluster of the Sea. The results obtained led to the conclusion that despite having a long road forward, Portuguese companies are committed to the sustainable development of their industries through sustainable innovations and with the right support from the government, this future will be achieved.

Keywords: Sustainability; Innovation; Portuguese Companies; Blue Economy

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Chapter 1

Introduction

1.1. Contextualization

As everyone starts to acknowledge, the world is at a breaking point regarding the average global temperatures due to many factors, including the excessive burnt of fossil fuels, and the overexploitation of livestock farming, for example. This situation calls for viable alternatives that can both meet the global demand for these sectors as well as being environmentally sustainable.

Over the past century technology has evolved in a faster flow that ever before and its tendency is to evolve even more giving us hope to face the climatic challenges that we have ahead.

The planet earth is mainly consisted of water and the human life depends on it. It is essential for humankind, and, despite having still a lot to learn about the oceans and their possibilities there is a subject that can already provide us with several sustainable applications of the seas that can be sustainable and develop the economy at the same time. This subject is called the Blue Economy (BE). The BE as a concept is quite recent, having been more used since the 2012 United Nation Conference on Sustainable Development in Brazil. It derives from the Green Economy concept.

Despite having different definitions across different authors, it is concurrent that BE consists of three dimensions: environmental sustainability; economic growth; and social equity. According to the world bank its definition is the sustainable use of ocean resources for economic growth, improved livelihoods and jobs, and ocean ecosystem health.

The European Union (EU) has developed an integrated maritime policy that aims to support the maritime economy. The purpose is to have a general and coordinated policy for all the maritime sectors allowing collaborative and efficient partnerships both between Member States and non-EU countries (Scholaert, Margaras, Pape, Wilson, & Kloecker, 2020). The EU provides funding programmes to support the development of the BE, focusing on five sectors: blue energy, aquaculture, coastal and maritime tourism, blue biotechnology, and marine mineral resources.

In 2012 the EU blue economy represented 5.4 million jobs and a gross added value of around 500€ billion per year (European Commission, 2012). The latest reports show that these numbers haven't changed much. However, there are some established sectors that are clearly evolving, such as the living resources, and the marine renewable energy.

Despite being a small country, Portugal has a large coastal area, which enables huge potential regarding the BE. According to some studies, the Portuguese BE already accounts for 5% of the GDP, 4% of the national gross added value, and 5% of exports. These stats have been increasing over the years, justifying the potential of the sector. Even through recessions, such as the 2008 one, the sector showed an incredible resilience by maintaining their revenues and jobs.

Some of the most promising sectors of the Portuguese BE are the sustainable aquaculture, ports and shipping, tourism, fishing, maritime renewable energy, maritime reforestation and macroalgae aquaculture, and the minerals extraction.

In 2020, Banco de Portugal statistics revealed that there were 2879 companies in the Portuguese BE, with a business volume of 4318 million euros and there were around 30,000 people working in the sector. Most of the companies are SME, mostly focused on fishing (74.75%), naval construction and repair (12.37%), and maritime transportation (12.89%).

Fortunately, Portugal, alongside the EU, has started to invest and fund different activities to develop the BE. In Portugal there is the Blue Economy's leadership programme, the Blue Growth program, the Portugal Blue program, and many more.

The research gap of this thesis is to explore how are Portuguese companies developing the BE sector and their innovations, since it is a very unknown sector for the overall Portuguese economy and its companies. In addition, it aims to describe the main difficulties companies are facing and what are the expectations for the future of the BE.

1.2. Research Problem

The blue economy industry is nowadays considered to be one of the future main economies, especially for countries that have large coastal areas as it is the case of Portugal. Unfortunately, there are many problems regarding the oceans, from water pollution, waste, deterioration of marine ecosystems to the overfishing of important maritime species, which altogether contributes to the fast climate changes and their inherent consequences for humanity.

Since Portugal has a large coast, this sector is very important for its general economy and if proven efficient it can put the country in the vanguard of the related industries. However, there is not much literature that can be found describing the Portuguese industry, which is why this dissertation will be presented. The research problem is how are Portuguese companies innovating and developing the blue economy industry?

1.3. Research Objectives

As previously indicated, this dissertation aims at identifying the innovation practices of Portuguese companies in the blue economy and how they contribute to the development of the industry. To accomplish this, it is necessary to establish some objectives for the work. The objectives that guide this work are: (i) the identification of the BE sectors being developed in Portugal; (ii) Identification of the innovations being developed and implemented by the Portuguese companies in the different sectors; (iii) Identification of challenges and barriers that influence the development of the BE; (iv) Identification of the prospects of the BE.

By the end of the dissertation, it is expected to have reached these objectives and be able to make a conclusion regarding the Portuguese blue economy reality.

1.4. Research Structure

This document is organized in five different chapters. In the first one a brief description of the BE is made. It is defined the research problem, the research objectives, and how this document will be structured. In the second chapter it is indicated and described the existing literature regarding the topic, and the research methodology that was adopted to gather its information. Further, on the third chapter it is described the methodology the author used in the empirical analysis of the research. The fourth chapter is the discussion of the results obtained. At last, in the fifth chapter is presented the conclusions, limitations and contributions of this research.

Chapter 2

Literature Review

2.1. Research Methodology

Although being a relatively new concept, Blue Economy (BE) has already a vast amount of available literature gathered in the last years. This literature review was elaborated through the study of several articles present in two databases, Web of Science and Scopus, as well as some EU articles. These databases were chosen mainly due to their wide recognition of gathering reliable and multidisciplinary research and due to the easy availability of several publications from numerous authors.

To collect the necessary data, some keywords were used based on some previous analyses of the economies and concepts related to the main topic, the Blue Economy. The keywords used were “Blue Economy”, “Sustainability”, “Innovation”. The criteria used were articles written in English, with open access dated from, at most, 10 years ago. To identify the articles that would be useful, a quick analysis was made through the abstract of the articles and were chosen the ones that were related to the topic and subtopics of this work.

This research led to different sectors of the BE that are organized in sub-chapters in the following text. The articles in which this information was obtained are also from the two databases mentioned and its references are at the end.

2.2. Blue Economy

The term Blue Economy is a considerably recent term that derives from the concept of Green Economy. It was first referred by the Small Island Development States to raise awareness for the ocean and its marine economy, however it was not defined yet (Silver, Gray, Campbell, Fairbanks, & Gruby, 2015, p.141-143). Due to its early age there is not yet a consensus, for its official definition, having different definitions across institutions and governments, but most of all concur in three dimensions, environmental sustainability, economic growth, and social equity (Voyer, Quirk, McIlgorm, & Azmi, 2018, p.598). These authors state that this ambiguity on its definition is caused by the different interests of the stakeholders.

To indicate some definitions, one was made by the World Bank and defines the BE as "the sustainable use of ocean resources for economic growth, improved livelihoods, and jobs, while preserving the healthy ocean ecosystem" (2017, p.6). The European Commission defines it as "all economic activities related to oceans, seas, and coasts. It covers a wide range of interlinked established and emerging sectors". The last example is the definition made by The Commonwealth of Nations that considers it "an emerging concept which encourages better stewardship of our ocean or blue resources".

Throughout the research made the most adequate definition for this work is the one from the World Bank, as the research of the different sectors of the BE seem to be according to.

Some authors acknowledge that the BE face conflicts between two of its dimensions, environmental sustainability, and economic growth as we have seen on land for many years, which proves the necessity of studying and assessing the interaction of the BE and the total environment (Lee, Noh, Lee, & Khim, 2021, p.2). One study acknowledged that there is huge economic potential for the BE sectors, but some measures have to be taken to avoid this inherent conflict (Ehlers, 2016, p.195-197). Ehlers enhances the importance of having an appropriate regulatory framework that must be supported by specific international agreements. He also concludes that this regulatory framework alone has no interest unless there is an ensured compliance made by the governments, as he calls it an Ocean governance.

Other authors go further on and indicate a new concept that might solve these two dimensions conflicts. It is the concept of Blue Growth (BG) which definition, according to Boonstra et al. is "aiming to achieve economic growth based on the exploitation of marine resources while avoiding their degradation, excessive use, and pollution" (R.M. Martínez-Vázquez, Milán-García, & de Pablo Valenciano, 2021, p.3). In a different study, a link was made between the BE and the Sustainable Development Goals (SDG) to try a different approach regarding the conflicts (Lee, Noh, & Khim, 2020, p.4). It was concluded that there are 5 SDG related to BE: objective 14 – underwater life, objective 15 – land ecosystems, objective 16 – peace, justice, and stable institutions, and objective 17 – alliances to achieve the objectives. However, the author recognises the challenges behind the implementation of the SDG, namely the different courses of action between different countries.

According to a communication from the European Commission (EC) to other European institutions there is a new approach towards a sustainable BE in the European Union (EU). In this document the EC indicates a maritime spatial planning, a tool aiming to reconcile nature

conservation with economic development (EU, 2021, p.16). It is said that this tool will promote synergies between economic sectors and will be coherent with both energy and climate plans.

Despite the conflict described previously, it is a fact that the BE is growing, and some authors believe that the focus will be offshore waters (Novaglio et al., 2021, p.3). The reason for this belief is that coastal waters are already over disputed and there are economic opportunities in the sea beyond such as the exploitation of deposits of minerals and the development of offshore wind energy, through surface platforms.

To better understand the meaning of offshore waters, the ocean can be divided into three zones with different characteristics: the coastal waters which are considered within 12 nautical miles (nm) from the shore, offshore waters that stretch from 12nm to 200 nm also known has Exclusive Economic Zone (EEZ), and areas beyond national jurisdiction, or commonly referred to as high seas (Novaglio et al., 2021, p.2-3).

The EEZ comprises the majority of BE capacity, where sectors such as bioprospecting, ecotourism, ocean energy and mariculture have higher resource availability, as well as fisheries and blue carbon, although the last two are more evident in particular locations (Cisneros-Montemayor et al., 2021, p.397). Considering that the EEZ are better monitored through jurisdictional oversight these findings are not a surprise.

An important aspect of the BE is the necessity to invest in research and innovation. The EU acknowledges that R&I is essential to reach the ambition of becoming climate-neutral in 2030 (EU, 2021, p.13). Following this recognition there are already funding programs in place meant to boost R&I in the EU, namely the Horizon Europe.

The Horizon Europe objectives are to tackle climate changes, achieve the UN's SDG, boost competitiveness and growth, facilitate collaborations, and the creation of jobs and diffusion of knowledge and technologies (European Commission, 2021, p.3). Regarding the innovation pillar, this funding programme has a budget of 10.6 billion euros destined to an European Innovation Council, European innovation ecosystems, and an European Institute of Innovation and Technology, aiming to support innovations, connecting regional and national innovation actors, and bringing together research, education and business to nurture innovation, respectively (European Commission, 2021, p.24).

The next table indicates some Interregional European projects that aim to disseminate knowledge and solutions for regions to adopt regarding a sustainable BE. Some projects have already been finished and others are still ongoing.

Table 2.2.1 EU projects

Project Name	**Objective**	**Timeline**
Smooth Ports	Reduce CO2 emissions in port areas	01/08/2019 – 31/01/2023
Passage	Reduce the consequences of maritime and logistics flows and activities on climate change	01/04/2016 – 30/09/2020
Islands of Innovation	Investigate and improve public policy measures to turn the islands into innovation “test-beds”	01/01/2017 – 31/12/2021
Cherish	Improve regional development policies to protect and promote cultural heritage in fishing communities to boost attractiveness for businesses, citizens, and tourists	01/06/2018 – 31/05/2023
Wildlife Economy	Support European regions in delivering sustainable growth, by improving policies for regional economic development rooted in their regional natural assets	01/08/2019 – 31/01/2023
Blue Green City	Improve policies that promote Green and Blue Infrastructure as an integral part of a local or regional natural heritage preservation strategy	01/08/2019 – 31/01/2023
Land-Sea	Establishment of joint guiding principles for promotion of interventions for regional growth in the field of the ecotourism and the related sectors	01/01/2017 – 31/12/2021

Impact	Changing management policies to promote productive activities in and around protected areas without compromising biodiversity conservation	01/04/2016 – 31/03/2020
Hericoast	Management of heritage in coastal landscapes	01/04/2016 – 30/09/2020
Extra- SMEs	Improving policies to boost SME competitiveness and extraversion in EU coastal and rural areas where aquaculture is a driver of the regional economy	01/06/2018 – 31/05/2023

Source: self-elaboration

According to authors Spaniol and Rowland there are two categories that encompass the sectors of the BE, namely the mature, and the emerging industries. Sectors such as maritime transport, shipbuilding, ports, fishing, and offshore platforms for hydrocarbon extraction are categorized mature, while renewable marine energy production, marine biotechnology, subsea mapping, mining, and aquaculture are categorized as emergent (Spaniol & Rowland, 2022, p.2).

Table number 2.2.2 indicates a few articles that regard specifically the BE and how their authors interpret the concept and some of its characteristics.

Table 2.2.2 BE articles

Author and Year	**Scientific Journal/ Book/ Article**	**Title**
Ehlers (2016)	WMU Journal of Maritime Affairs	Blue Growth and ocean governance – how to balance the use and the protection of the seas
Voyer et al. (2018)	Journal of Environmental Policy & Planning	Shades of blue: what do competing interpretations

		of the Blue Economy mean for oceans governance
Lee et al. (2020)	Environment International	The Blue Economy and the United Nations' sustainable development goals: Challenges and opportunities
Martínez-Vázquez et al. (2021)	Environmental Sciences Europe	Challenges of the Blue Economy: evidence and research trends
Novaglio et al. (2021)	Reviews Fish Biology Fisheries	Deep aspirations: towards a sustainable offshore Blue Economy

Source: self-elaboration

In an older article, Ehlers stresses the fact that the economic value of the oceans is increasing over the years, and with that there are threats to the safety of ocean ecosystems. He explores some different sectors of the BE and then concludes by stating that it is important to find a balance between the use and the protection of the seas.

The second article by Voyer et al. recognises that defining the BE can be ambiguous due to four different interpretations that conflict between them namely Oceans as natural capital, Oceans as livelihoods, Oceans as a driver of innovation and Oceans as good business. He concludes by saying that it may be possible to accept the conflicts and use it for flexibility and adaptability.

The author Lee develops the connection between BE and the SDGs. Despite this connection it is expressed the concern for the adaptability of the BE to the SDGs meaning that it is not clear where the BE sectors and practices meet the actual goals established by the UN. He concludes saying that it is important to identify BE's key stakeholders to align with the SDGs.

The fourth article focus on the trends of some concepts related to the BE, such as Circular Economy (CE) and Blue Growth (BG) and explores their relationships. While the CE is oriented towards the environmental sustainability through reduction of waste and efficient use of

resources, the BE has an economic strand that often conflicts with the environmental one. The authors conclude that the linkage between these two concepts is the BG, which is a strategy that incorporates the CE to achieve a sustainable BE.

Novaglio et al. focused their article on the offshore waters. They believe the offshore waters to be the future of BE expansion. However, they mentioned that this expansion cannot be done with the same practices, known as business as usual, but rather with more sustainable ones. There is potential in offshore waters, either by the expansion of renewable energy platforms or the exploration of the sea floor in search for metals. They conclude by saying that despite its importance, the environmental implications of exploring these waters must be considered, and that this expansion must include the SDGs in its planning.

In the following subchapters some different sectors of the BE will be exploited, especially their characteristics and challenges. The sectors presented are fisheries, blue carbon, aquaculture, processing sector, coastal and maritime tourism, maritime transport, ports and shipbuilding, marine resource extraction, offshore wind and ocean energy, innovation, and social equity.

2.3. Fisheries

As one of the oldest blue economy sectors, fishing is an essential sector of the global economy, and the global seafood consumption has been increasing year after year (Scholaert, 2020, p.18). Despite the government's efforts, most of this consumption is from wild catches instead of farmed seafood, which represents a threat to the marine ecosystems and its species. The natural biological replenishment time of species is not being respected. With increased demand, there is increased fishing in a shorter period.

However, some fishers, often, are more concerned about their business rather than healthy ecosystems, as it is the case of the stocks in the Mediterranean and the Black Sea (Scholaert, 2020, p.19). While on the North-East Atlantic Sea the maximum sustainable yield (MSY) is almost reached, in the Mediterranean there are data showing long-term overfishing which surpasses the MSY by more than double.

Beside the impact that fishing has on the quantity of maritime species it also impacts the species through the fishing gear that gets wasted in the sea. Fishing gear and single-use plastic products represent 70% of marine litter in the EU (EU, 2021, p.6). According to the EU report

the solution is based on designing gear that can be reused and recycled when it becomes obsolete and provide financial support to fishers that retrieve and collect litter and wasted fishing gear as it is already a practice in the EU.

Another concern for the EU regarding this sector is to reduce unwanted catches and discards (EU, 2021, p.10). The focus is the digitalisation and use of advanced tools for fishing operations which will support the sustainable management of the sector by collecting and analysing data improving control and monitoring of the sea and its species being more precise and reducing the probability of catching in excess and then wasting.

Despite all these factors that endanger the ocean, and more specifically, the fishing sector there are authors that criticise the EU approach to develop the sector. According to an article focused on small-scale fisheries (SSF) the EU is not taking into consideration the role of the SSF in their development plans for the BE.

Authors Ayilu et al. indicate that the current fast changes and ambitions in the BE are exposing the fragility of SSF regarding their competitors (Ayilu, Fabinyi, & Barclay, 2022, p.1). A good example of this is mentioned in (Sulanke & Rybicki, 2021, p.2) where is stated that globally, since the second world war, subsidies were mainly issued to large-scale vessels while only 7% were for the SSF, increasing their gap.

They say that although innovation is a priority for ocean sectors, that SSF are neglected about its innovation potential. Not only for innovation but for development overall (Ayilu et al., 2022, p.5) which is also mentioned by Sulanke and Rybicki that say that the European Blue Growth strategy focuses on five sectors regarding the highest potential for sustainable growth, and neither is SSF (Sulanke & Rybicki, 2021, p.2).

However, there is an example of an innovation in Uganda local fishermen that increases wages while reducing food waste and childhood malnutrition (Clark Howard, 2018, p.1). The innovation is rather simple, and it’s called Mukene fish powder, which consists of the processing of the disposed heads, bones, and organs of the fishermen catches. These materials are dried and then grinded into powder that has important minerals and vitamins that can be stirred into stews for consumption.

Overall these authors defend that SSF should be guaranteed equal involvement in the blue economy future, whether it is physical, economic or political involvement (Ayilu et al., 2022, p.9). Sulanke and Rybicki suggest the establishment of Community Development Quota

schemes to strengthen the economy of coastal communities and foster blue growth in SSF (Sulanke & Rybicki, 2021, p.2). These schemes consist of a public board or council that holds and manages part of the quota shares on a stock on behalf of the community as they explain in the article.

2.4. Blue Carbon

One of the many subjects related to BE is the newly called Blue Carbon (BC). To fight the climate changes the most important objective is to reduce the carbon emissions, however, countries are reluctant about reducing their emissions with urgency due to the economic impact it causes. Therefore, it is necessary to find complementary practices to help limit the climate change and the concept of BC is one of them. BC is characterized by the sequestration of organic carbon by the oceans and their coastal ecosystems, through their aquatic vegetation such as seagrass meadows, and mangrove forests, for example (Macreadie et al., 2019, p.1).

The BC ecosystems mentioned above have the capacity to stock and accumulate large amounts of organic carbon in their soils (Lovelock et al., 2017, p.2) which makes it so important to preserve and restore them, since their degradation not only mean the release of accumulated carbon as well as the loss of capability to mitigate future carbon emissions.

According to some studies, despite having a small impact, globally, at sequestering the land carbon sink, the mangroves forests can have a good impact on a national level for countries with big coastal areas (Taillardat, Friess, & Lupascu, 2018, p.2-3). Many authors consider that preserving this ecosystem and avoiding its deforestation is very important since it is the one that stores more carbon, mostly on their soils (Kauffman et al., 2020, p.2), which means that if these ecosystems are harmed, not only they stop sequestering carbon but also release their huge carbon stock amounts leading to more carbon emissions.

As mentioned above, seagrass meadows are also part of the BC concept as one of the ecosystems that sequester and stock carbon. Its main advantage is their global distribution, when compared to mangroves forests - limited to tropical and sub-tropical zones - that contributes to carbon storage and accumulation. As a result of its ability to trap suspended particles some authors consider that seagrasses accumulate more carbon than terrestrial soils, per unit area (Lima, Ward, & Joyce, 2020, p.2).

According to an EU report the blue carbon sequestration also contributes to the preservation of coastal biodiversity.

2.5. Aquaculture

As mentioned before, one of the pillars of the BE is the economic growth, and the growing development of aquaculture is a major provider to that end. It's definition regards the farming of fish, shellfish, algae, and other aquatic organisms and takes place both in inland and marine waters (Scholaert, 2020, p.19). The fact that there is an increased demand for seafood and that aquaculture already provides a large percentage of the global food production (Guenard, 2021, p.5) make the countries focus their attention in the development of the sector. Moreover, it has the potential to support and contribute to the well-being of coastal communities by providing new jobs, new infrastructures, and seafood trade, for example (Campbell et al., 2021, p.2).

Despite its importance, there is a huge gap between the aquaculture production around the world. According to some EU reports, although there was an increase in worldwide aquaculture food fish production, the EU production maintained its levels for a long period of time (Scholaert, 2020, p.20). In fact, in 2016 the EU production accounted only for 1,6% of global production while Asia accounted for almost 90%. Considering that the EU has a large coastal area, these stats reveal an opportunity to improve and develop this sector of the BE, which can lead to an increase of the economic growth of the EU.

According to an EU report, the exploitation of algae is a potential course of action to deal with the extensive food production sector. It is considered a viable and sustainable alternative food and feed material (EU, 2021, p.10). Investing in micro-algae has numerous advantages: first it can help reduce catches of wild fish for animal feed, and second, producing algae in the sea can help removing excess harmful gases from the water, such as carbon, nitrogen, and phosphorus.

However, there can be harmful aspects of aquaculture, namely in mariculture. Mariculture is a branch of the aquaculture sector that cultivate, manages, and harvests marine organisms in their natural environment or in enclosures such as tanks (Sumaila, 2022, p.3). Despite its positive benefits already considered, mariculture can lead to the opposite of its main objective by decreasing the local food availability if they use fish to farm feed its tanks and farming zones, and can also degrade the habitats of important species such as mangroves (Cisneros-

Montemayor et al., 2021, p.4). Another potential harmful aspect is the possible exploitation of exotic species that are not natural from the regions where they are being farmed, and if they escape they become a threat for the local ecosystems (Senaratne & Zimbroff, 2019, p.10). The use of exotic species can be explained by the higher prices practiced on markets.

An important feature of this industry is the offshore aquaculture that relies on the technology available. Due to the competition between industries for the ocean space, it is considered that in the future, new technologies will have to emerge to allow the aquaculture installations to move further away from the coast. It will benefit the different companies by clustering farms and reducing the costs related to shared infrastructures (van den Burg, Aguilar-Manjarrez, Jenness, & Torrie, 2019, p.1).

2.6. Processing Sector

Complementary to the fisheries and aquaculture sectors, the processing sector in the BE is also important generating a gross added value of 6.1 billion euros in the EU. It is characterized by the processing, preservation of fish and fish products, and production of fish, crustacean and mollusc products (Scholaert, 2020, p.21).

Contrary to the other sectors, it is estimated that more than half of the workforce is constituted by women, more specifically in Portugal is up to 67%.

Despite being an important sector, processing has low profit margins. This can be explained by the EU supply of raw materials, namely fisheries and aquaculture, being unable to meet the demand. Therefore, the sector is dependant of imports, which combined to the rising costs of both raw materials and energy leads to low profit margins.

Although in the European countries this sector is well developed, there are certain countries, mostly the poorer ones, that don’t have the necessary conditions to process food properly, as it is the case of Kenya. According to Odoli et al. in Kenya the fish processors use basic techniques such as smoking, drying and deep frying the fish (Odoli et al., 2019, p.7). Regardless of the government efforts to introduce new technologies in the sector, somehow it was not adopted by the locals.

This article is a good example that there is still a long way to go in some poor countries regarding the processing sector. There is a need to educate the fishing communities to achieve nutritional security, reduce waste and guaranteeing food quality (Odoli et al., 2019, p.10).

2.7. Coastal and maritime tourism

Perhaps one of the most known sector of the BE the maritime tourism is the biggest employer of all. Its range of activities is wide, mainly water-based, such as nautical sports and cruising, for example, but on land it has also its options, such as beach-based tourism.

This sector represents a very important role in the economic development of coastal regions. It creates opportunities for the local population by increasing their income, development of infrastructures, creation of new jobs and businesses (Scholaert, 2020, p.23).

From the economical perspective this sector is beneficial, as we've seen. However, from the ecological point of view, mass tourism leads to pollution, waste, wastewater, and noise which can also be negative for the local inhabitants. According to some studies an effective way to tackle this problem is applying an Integrated Coastal Zone Management (ICZM) (Sotiriadis & Shen, 2020, p.5). The ICZM focuses on the interrelationship between tourism management and environmental protection. As mentioned before, often the maritime tourism impacts negatively the coastal areas which can be explained through a series of factors that challenge the sector, such as the inexistence of shared benefits of tourism with local communities, poor investment capacity, and the weak response capacity of local communities (Sotiriadis & Shen, 2020, p.6).

However, according to some worldwide case studies from Italy, Hong Kong, China, Kenya, and Australia there are some practices related to the ICZM that show that it is possible to have a sustainable tourism management (STM). Sotiriadis and Shen concluded, through their analysis of these case studies that to achieve a STM a collection and analysis of data regarding the local conditions of the coastal zones is necessary, along with a long-range planning that encompasses short, medium, and long-term positive impacts on the coastal zones. Also, it is necessary to adopt an adaptive management policy, with flexibility to adjust according to the circumstances and feedback. Lastly, and extremely important is to conduct a participative planning with the local stakeholders, throughout the whole plan and its implementation. The authors refer that tourism management should be sensitive to local stakeholders' expectations.

Although the presence of challenges will always exist, and adjustments are always necessary through time, these practices related to ICZM have proved themselves to be a reliable pillar to the balance between tourism and environment protection.

Maritime tourism also englobes the Small Island Development States (SIDS) which are famous for their paradisiac beaches and crystal-clear waters. In fact, the main engine of these SIDS economy is the tourism which is the reason for SIDS being more focused on BE rather than continental countries. However, it also makes them more vulnerable to the challenges that comprise the BE sectors, namely the tourism sector.

Among threats and vulnerabilities, the ones that stand out are the climate changes and the unsustainable tourism. The climate changes will cause a rise in the sea levels that will submerse a lot of islands and damage the economy of the remaining ones through the damage of infrastructures that are essential for the local people to thrive and survive. Moreover, the growing tourism on these SIDS has harmful aspects associated with the depletion of freshwater resources and increased waste (Senaratne & Zimbroff, 2019, p.5).

2.8. Maritime transport, ports, and shipbuilding

There are three BE sectors that are linked but can be described separately: shipbuilding, maritime transport, and ports. Along with fishing, shipbuilding is a very old sector, and what started as simply building wooden ships to explore the world, nowadays there are a lot of different features from the sector. The EU has specialised in building cruise ships, technologically sophisticated, producing marine equipment, and providing products and services for ship maintenance, repair and conversion (Scholaert, 2020, p.25).

Although employment has been dropping, the sector accounts for 8% of jobs in the BE, revealing how important the sector still is. One of the main threats to the sector is the fact that the workforce is getting old and not being replaced by younger people at the same pace, which puts at risk the knowhow transmission and naval security.

The maritime transport sector includes coastal and short sea shipping of passengers and goods, inland water transport, and the rental and lease of water transport equipment. Most of the world trade volume is made by sea which makes it a crucial sector for all economies around the world. It employs 6% of the total workforce in the EU BE, and the main challenge of the sector is to reduce its impact on the environment and climate, considering that transport demand from trade is growing (Scholaert, 2020, p.26). A continuous threat to the sector is the piracy that grew over the past decade near the Horn of Africa, having already been reduced due to a combined task force between countries (Senaratne & Zimbroff, 2019, p.12).

The last sector to consider is the ports, which englobe the previous two sectors. They can turn into maritime clusters, including shipbuilding and maritime transports. On top of that, ports are characterized for dealing with cargo handling, warehousing and storage, construction of water projects and services related to water transportation. Considering all the activities mentioned it's not a surprise that the percentage of employment in the EU BE is of 14%.

Once again and considering all the fuss that can be present in ports, the direct consequence for the sector is the increase of traffic, leading to congestion and pollution.

2.9. Marine resource extraction

Considered an established economic sector of the BE, the marine extraction of minerals has different interpretations. On one hand this sector is declining, due to low selling prices, high production costs, and the development of new onshore exploitation techniques. On the other hand it has the potential to improve in some places, such is the case of the Indian Ocean (Senaratne & Zimbroff, 2019, p.10).

Although the main interest has been common metals, with the developing of renewable energies it becomes crucial to mine rare earth metals, and since the land-based sources are decreasing, it is only natural to focus on the deep sea. However, according to Senaratne and Zimbroff the logistics and procedures behind this sector are very complex and there are factors at stake, such as the environmental concerns, that make deep seabed mining having good potential but not yet fully achievable, at least not sustainably and efficient.

2.10. Offshore wind and ocean energy

Among the emerging and innovative sectors of the BE, the offshore wind is proving to be an extremely valuable sector for the future, both from an employment perspective and an environmental one. Nowadays more than 10 million houses in the EU are already powered by offshore wind electricity and it is expected to become the largest source of electricity for the EU in the 2040s (Scholaert, 2020, p.28).

Moreover, the ocean can also provide another source of electricity, through tidal and wave power, called the ocean energy. It is a small sector yet in the EU but shows great potential. Nevertheless, its production costs are still high and need R&D funding to try and meet its potential.

2.11. Innovation

The threat of the climate changes has many people relying on technology and future innovations to help humanity adapt and face its inherent challenges. The exploitation and development of the sectors regarding the BE have, in a way, the same ambition.

Authors Nagy and Nene acknowledge the importance of innovation to further develop the BE in Africa to target climate change, poverty and disease situations (Nagy & Nene, 2021, p.2). They defend that the transition to sustainability is highly linked with innovation, both in the economy as well as in the governance (Nagy & Nene, 2021, p.9)

Complementary to Nagy and Nene, other authors highlight the importance of investing and developing observation innovations to help understand and manage the ocean ecosystems (Stevens, Jolly, & Jolliffe, 2021, p.11). Stevens et al. believe that ocean observation is key to understand the link between the Ocean and climate changes and to assure its sustainable use.

Further on this paper, Stevens et al. indicate some technological areas in which innovation will help improve data gathering and analysis. These areas are Ocean sensing and imaging instruments, the expanding spatial coverage of float arrays and fixed observations platforms, increasing autonomy in mobile platforms, and new complex systems integration schemes (Stevens et al., 2021, p.13).

One of the worst consequences of climate change is the destruction of coral reefs around the world. However, in the Red Sea there are coral species that can withstand harsh warming events without severe mass-bleaching (Cziesielski et al., 2021, p.7).

According to the author, there is ongoing research to understand and recreate the genetic traits and conditions that are responsible for the Red Sea corals high thermal resilience. This can represent a very important innovation for the future of marine ecosystems around the globe.

On another sector of the BE, aquaculture, there are companies focusing on innovation to solve problems and collect benefits. In an article written by Rubilar and Cardozo there are two companies, one in Norway and the other in Argentina that focus their research on sea urchins (Rubilar & Cardozo, 2021, p.2).

In Norway, they are tackling the overgrazing kelps along the coast by harvesting sea urchins in a land facility that can produce and improve the quality of the roe of sea urchins. The

innovation is the harvesting and production of this aquatic species in a land facility which aims to restore the ocean habitats and develop a sustainable food production (Rubilar & Cardozo, 2021, p.5).

Another company, in Argentina, uses the same species, the sea urchins, but targets the human health. Their innovation is to produce biological active additives based on sea urchin eggs to prevent chronical disease in humans (Rubilar & Cardozo, 2021, p.6).

As the BE is gaining much more visibility and importance, the EU is funding projects that rely on innovation and prove to be sustainable. In Portugal, despite having a large coastal area, the BE sectors are not fully efficient (Fontes, Sousa, & Conceio, 2019, p.2).

However, Portuguese companies are participating in these European funded projects mainly through the development of knowledge about marine resources, the impacts of human activity and courses of action to reduce them (Fontes et al., 2019, p.7).

Throughout this sub-chapter only a few innovations were indicated, though there are certainly many more in the various industries related to the BE. As mentioned, BE has immense potential if innovation and investment are provided.

2.12. Social Equity

Lastly, this sub-chapter does not regard a sector of the BE, but rather a concept that is important for the social component of any industry, which is the Social Equity (SE). The term Social Equity combines the concern for fair and equal treatment of all communities, individuals and groups, regardless of their characteristics, in the development, implementation, and enforcement of laws, regulations, and policies (Österblom et al., n.d., p.8).

Despite its general importance in every industry SE has a crucial role in BE. According to Cisneros-Montemayor, BE cannot contribute to the SDGs unless it focus on social benefits and equity as much as they focus on environment and economic challenges and growth (Cisneros-Montemayor et al., 2019, p.1).

Although it is recognised the importance of developing the BE, some critiques are being made regarding the neglection of the social impacts this development can cause (Nathan James Bennett, Blythe, White, & Campero, 2021, p.2). Some harmful consequences are the dispossession, displacement and ocean grabbing, pollution and waste, environmental

degradation, and reduction of availability of ecosystems services, inequitable distribution of economic benefits, human and indigenous rights abused, and the exclusion from decision-making and governance.

There is a common conviction that too much focus is being drawn towards the economic growth and sustainable environment neglecting the social issues that are too part of the BE concept (Cisneros-Montemayor et al., 2019, p.2). Some criticisms are made towards the injustice of policy-makers only being focused on the desired outcome instead of worrying about the whole process and the social impact it may have (Nathan J. Bennett, 2018, p.2).

Regardless of these courses of action, there is still potential to achieve an inclusive, equitable, sustainable, and beneficial economic BE (Nathan James Bennett et al., 2021, p.6). In fact, some projects were conducted in both China, Samoa, and Vietnam which explored the potential socio-economic benefits of supporting these communities and the results revealed that economic growth, environmental preservation, and social equity can all be achieved together when using inclusive policies and actions (Chen, De Bruyne, & Bollempalli, 2020, p.2).

These projects targeted the restoration and sustainable use of seagrass beds for sea cucumber aquaculture in China, the coral reef restoration and sustainable fisheries in Samoa, and the community-based management of coastal and marine resources for livelihood improvement in Vietnam.

In China, the project relied on an innovative method of seagrass reproduction and restoration. The socio-economic results were an enhanced local capacity in marine conservation by the communities, empowered women contribution, development of the tourism, and the increase of the local weekly income (Chen et al., 2020, p.6). The key for this successful projects was the community participation and ownership.

In Samoa, the objective was to protect and rehabilitate the marine biodiversity. They cleaned their corals through the remotion of an invasive species that affected the corals, they banned dangerous fishing practices and planted coastal trees to protect the coastline from erosion (Chen et al., 2020, p.7). The project improved awareness to the conservation of marine ecosystems and improved the weekly income through better fishing catches.

In Vietnam, they created a fishermen’s community association with a decentralized approach to exploit aquatic resources where there was coordination and benefit-sharing among local stakeholders. The result was a decrease of more than 90% of fishing violations, the

restoration of seabed ecosystems and an increase of income both on fishers and alternative livelihoods (Chen et al., 2020, p.10).

Despite recognizing the disparities between nations and their governance of the sea and within its sectors, Cisneros-Montemayor allude to the fact that the ocean resources are not uniformly scattered, which means that different locations will not be able to develop several BE sectors simultaneously (Cisneros-Montemayor et al., 2021, p.4). Therefore, a winning approach that serves all does not exist, instead there are different areas, with different enabling conditions and availability of resources that must be addressed specifically by targeted investment and inclusive decision making.

2.13. Main Considerations

Considering everything written before it is evident that the BE has an important role in the future of the world. Countries all over the world are already starting to understand the challenges the climate changes will bring and are more receptive to undertake different approaches.

However, as it was mentioned, there are still a lot of environmental and social concerns that need to be taken more seriously. The policymakers and decision-makers need to be more inclusive and rely on the local communities to implement measures that serve all and not only the economic stakeholders.

Moreover, the development of new technologies is needed to expand the sectors of the BE. Therefore, is important to invest in innovation and encourage the development of knowledge and research in all areas. To further develop some sectors, such as marine extraction or the use of renewable energy platforms on the ocean, for example, it is necessary to develop more precise, reliable, robust, and autonomous infrastructures and equipment's.

Chapter 3

Research Methodology

Having analysed the existent literature and their theoretical assumptions and practical examples regarding the BE, it is important to focus on the research problem, "How are Portuguese companies innovating and developing the blue economy industry?". This chapter aims to describe the methodology that was used to develop the research.

3.1. Research Context

As mentioned before, the Blue Economy has potential to both mitigate climate change as well as develop economic growth and social equity. Since Portugal has a large coastal area, it is important to explore and describe how this sector is being managed and how efficiently. According to some studies, there is evidence that new technology intensive firms are working together some traditional sectors to exploit new opportunities regarding the ocean activity, such as fisheries, aquaculture, and food processing (Sousa, Fontes, & Conceição, 2020). This study acknowledges that Portuguese policies are congruent with the ones established by the European Union which improves the partnerships of Portuguese firms with foreign ones. However, it also mentions that are some sectors that are being left behind requiring additional effort from the policy makers to address them.

Taking this into account this works aims at expanding the existent knowledge regarding the Portuguese Blue Economy industry and potentially be a source of relevant information regarding the sector.

3.2. Research Methodology

For this research it was chosen the qualitative research method. This method allows the participants to freely express their opinions and beliefs which enables the author to understand the research problem as a humanistic approach (Babu, Maiya, Shah, & Veluswamy, 2013). Additionally, a qualitative research method has the potential to contribute with new insights beyond the one's expected or anticipated by the author (Aspers & Corte, 2019, p.15).

The choice of this method was based on a direct approach through a single interview to 7 different companies to explore their practices, motivations, attitudes, challenges, and insights regarding their work and the BE different sectors. The interview was based on a previously structured guide, allowing the interviewees the freedom to use their own words and using as much time as they needed. The author decided to have a cross-sectional design to benefit the companies regarding their time availability.

Finalised the description of the research methodology used it is relevant to analyse the sample of the research and the sample methodology.

3.2.1. Sample

As mentioned before, the aim of this research is to identify how are Portuguese companies in the BE innovating and developing the industry. To do so, several companies were identified in the Portuguese Cluster of the Sea website. The Portuguese Cluster of the Sea has a mission to reinforce the dynamic of the strategic cooperation between economical actors and promote competitivity in the principal chains of value that use the sea and the maritime resources has central elements of their activity, to contribute in a sustainable way for the economic growth, exports and employment also improving the relative importance of the BE in the national economy.

Since it was not possible to collect data from every company listed, due to difficulties such as time and resources available, it was considered, for this research, a representative sample of the total population consisted of 7 companies.

The companies were contacted via e-mail, and phone calls. Many attempts were made to include a bigger sample, but out of 32 companies initially contacted, only 7 took part of this research which represents a response rate of 21,88%.

3.2.2. Data Collection

As previously mentioned, the data collection was made through a set of semi structured interviews to general and innovation managers of the companies. The interviews were conducted between June and August of 2022 and were realised through the platforms Zoom and Microsoft Teams. They were structured to have a maximum of 30 minutes, having the majority lasted less, and only one was extended some minutes. The companies were firstly contacted via email where it was appealed the necessity of collaboration between the academia and the corporate system, having been described the research purpose, and context. The e-mail

also contained a privacy disclaimer, according to the general privacy data protection procedures and the use of the of the data collected was used exclusively for activities related to this research.

Additionally, a phone called was made to each of the non-respondents to try and increase the number of participants which proved to be successful. The guide, exposed in the appendix, is composed of 28 questions, open answers, and was elaborated based on the research problem and research objectives. In the interview its recording was asked, to facilitate the transcription and analysis of the content. All companies agreed.

3.2.3. Data analysis

Once collected all the information from the interviews, the data was subject to data treatment methods at a qualitative level, through a content analysis. The content analysis consists of investigating the existence of content patterns, by reading and observing the data and assigning codes to interesting and significant content. For ethical reasons, and to safeguard the companies' privacy, their anonymity was maintained, and any possible harmful aspects were omitted.

For this purpose, the software MAXQDA 2022 was used. This software is a complete qualitative analysis tool, that is often used in the academia because it facilitates the organization, systemization, analysis, and presentation of qualitative data prevenient from different sources and with different formats.

As mentioned, the identified significant content was coded which was then followed by a systemic comparison process to all data collected from every interview to identify similarities, and divergencies between categories. The codes represent different categories that were identified in every interview, as it was intended by the structure of the interviews. Overall, 83 codes were identified through the data collected.

Chapter 4

Results and discussion

This chapter identifies and analyses the principal results of this research. Initially a brief description of the companies is made followed by the analysis of the significant content identified through the coding system used in the MAXQDA 2022 software.

4.1. Sample characterization

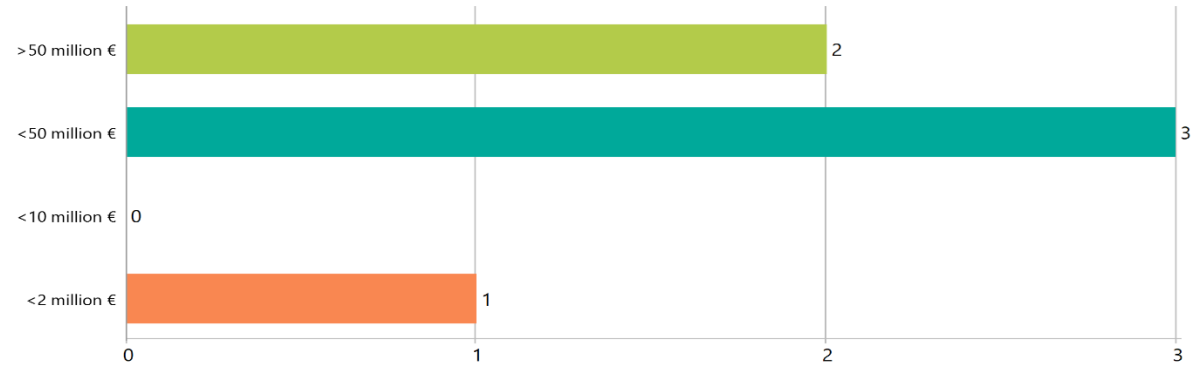
As previously mentioned, there was a total of 32 companies contacted, both by electronic mail and phone calls. However, only 7 companies were available to conduct the interview and provide valid data.

Table 4.1. Number of interviews; sample size

Companies contacted	Total	32
	Participated	7

Source: self-elaboration

To better identify and characterize the sample, it is necessary to describe the companies' main characteristics, such as annual income (**Graphic 4.1.**), and number of employees (**Graphic 4.2.**).

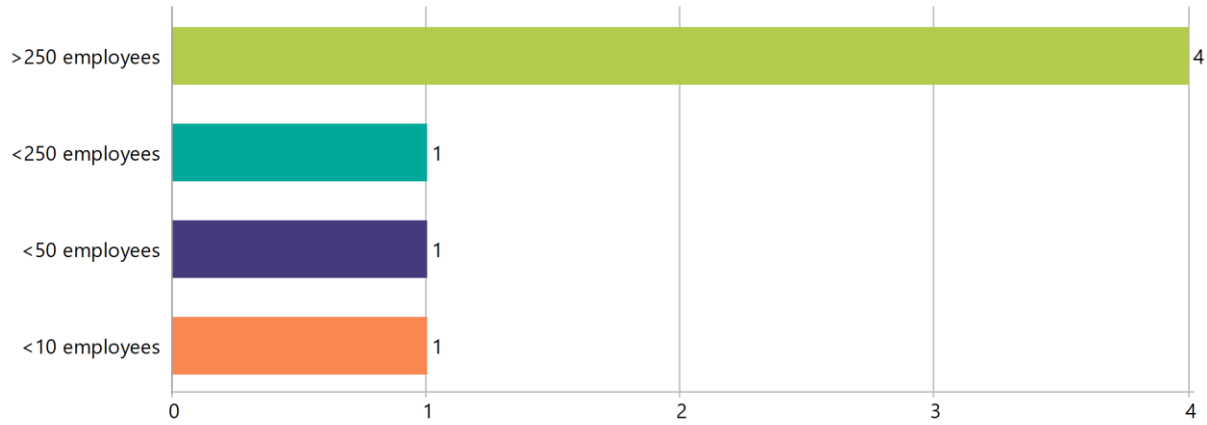


Graphic 4.1. – Annual turnover

Source: self-elaboration through MAXQDA 2022

Part of the criteria to characterize a company is based on the annual turnover. If a company has less than 2 million euro of annual turnover is considered a micro company. If the annual turnover is below 10 million euro of annual turnover is considered a small company. Further,

with an annual turnover of below 50 million euro is considered a medium-sized company, and above these values is considered a big company.



Graphic 4.2. Number of employees

Source: self-elaboration through MAXQDA 2022

The other part considered to characterize a company is the number of employees. A micro company has less than 10 employees. A small company has between 10 and 50 employees. Above 50 employees and below 250 employees is considered a medium-sized company. Lastly, if a company has above 250 employees it is considered big.

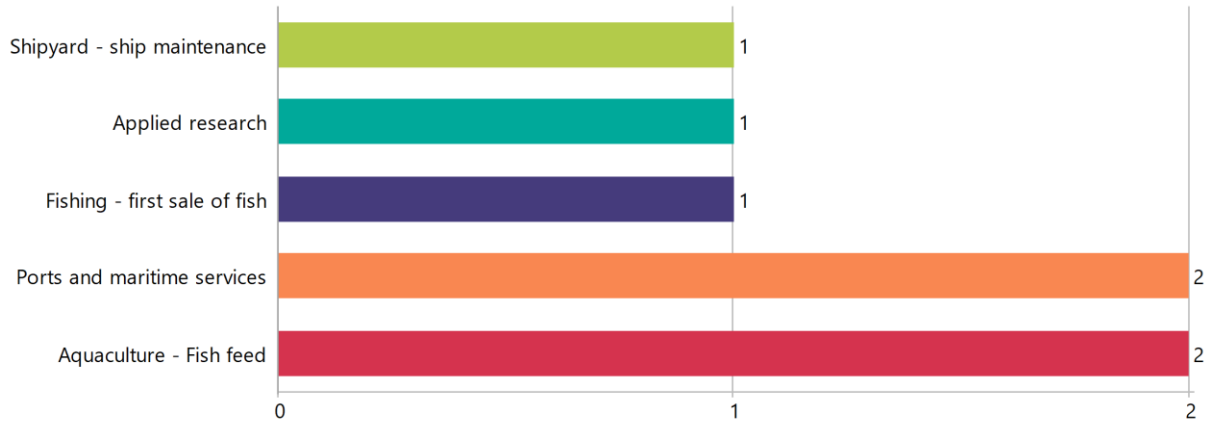
According to both graphs we can see that the companies participating in the questionnaire have different number of employees and annual turnovers. We can characterize the sample as having 2 big companies, 2 medium-sized companies, 1 small company, and 1 micro company. Since there was a company that was not able to indicate their annual turnover, it was not included in this characterization.

4.2. Results

The results obtained through the analysis of the data gathered will be described in the following sub-chapters. They are divided by the proposed objectives that the author mentioned in the first chapter of this research and connected to some of the articles presented in the second chapter.

4.2.1. Identification of the BE sectors

The following graphic (**Graphic 4.2.1.**) identifies the different sectors to which the companies sampled are included.



Graphic 4.2.1. Blue Economy sectors

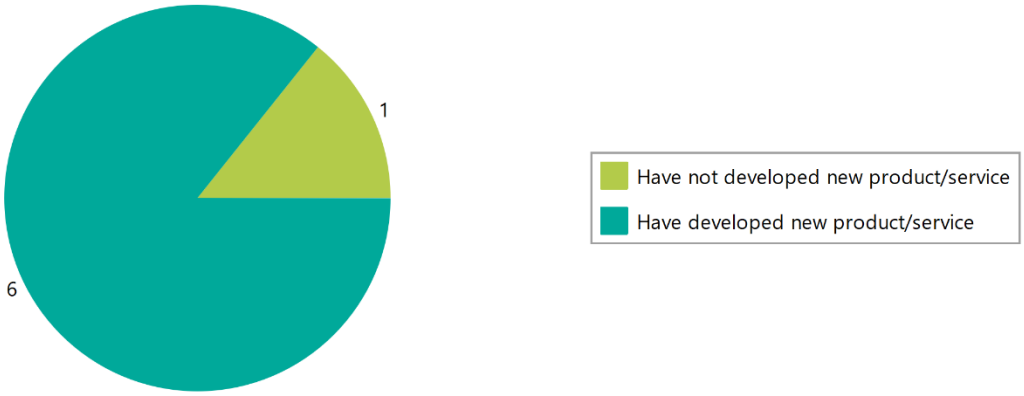
Source: self-elaboration through MAXQDA 2022

Although there are many more blue economy sectors, the gathered data includes just 5 sectors, as shown in the graphic above. There are two companies integrated in the ports and maritime services, 2 in aquaculture, and 1 company for both shipyard, applied research and the first sale of fishing. Although there is just one company that focuses exclusively on applied research, some of the others also have this dimension in their innovation departments where they try to develop innovations or in some cases, they host companies in their facilities to promote a geographical proximity with the sea, the main example being ports and shipyards.

4.2.2. Innovation

The main topic of this dissertation is to analyse how innovation is being developed in the Portuguese companies, and which are the main challenges they face. The following graphs describe how many companies are developing new products/services, how these innovations are being funded, who are the main actors behind the development of the BE, and which are the main challenges and barriers to the companies.

To try and understand the Portuguese innovation products the author inquired the companies if they created any innovation already.



Graphic 4.2.2.1. – Innovation products/services

Source: self-elaboration through MAXQDA2022

Has a result, the author found that almost all companies interviewed have developed some new product/service in their sector.

The aquaculture sector gathers their innovation from scientific research. The companies in this sector explore and study the impacts their feeding products and procedures are having on the fish health. Therefore, their innovation involves experiments with new feed procedures and methodologies. They're objective is to develop the right components that will boost the fishes' immune system to avoid diseases and improve the quality of the product that is delivered to the consumers. They are also exploring the benefits of alternative protein sources such as algae and insect to help decrease the dependency of fish consumption, due to the high pressure the maritime ecosystems are having through excessive fishing.

The other BE sector that has a higher representation in this sample is ports**.** Being a sector that provides services instead of developing products, their approach is to develop more sustainable processes. The most important innovation ports are making is making a digital transformation, by improving their processes efficiency through the development of an electronic platform that connects all the services they provide. It is a tool that facilitates interactions between cargo that is being hold in the port to the different entities, such as the owners, the transporters, and the concessionaires, for example. This was an innovation that allowed the port to both reduce bureaucracy and remove the use of paper.

Besides, Portuguese ports are renting, in their infrastructures, some research laboratories to allow research companies to conduct their maritime studies and develop their innovations in a strategic geographical point, near the ocean. Additionally, ports are facilitators for different

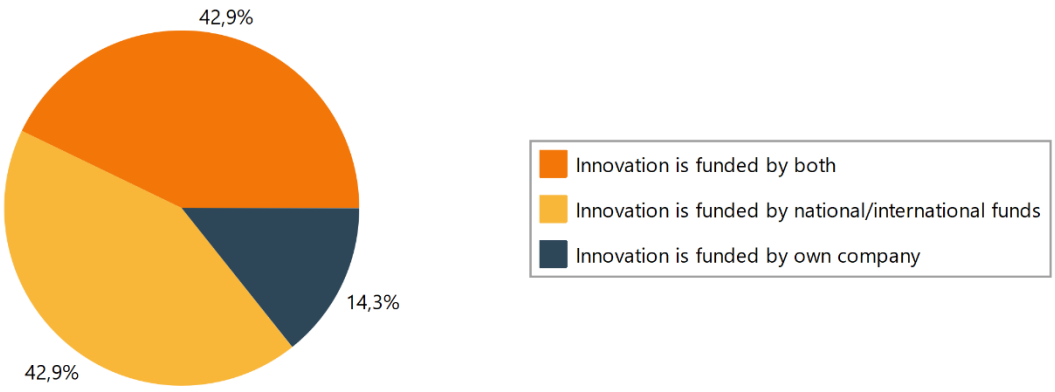
maritime projects, such as offshore wind energy platforms, providing support and some logistical services.

Although the fishing sector is represented by a company whose main activity is the first sale of fish instead of the fishing itself, there is room for innovation as well. Developing an electronical auction was a pioneer innovation that led the path to several other European companies in the sector. The next step is developing an on-board auction through the fishing boats. The concept consists of a feature that schedules an app to open the hake auction while the fish is still on the vessel.

Shipyards main activities are to construct boats and do their maintenance. Their innovation is based on developing sophisticated sonars and boat accessories that enhance not just the performance and sustainability of the boats but can improve maritime routes by scanning the sea and gather more detailed data from the ocean's ecosystems.

Lastly, the applied research company is more like a consultancy company where they help their clients to overcome some technical difficulties in the various BE sectors through the development of high technological products, after exhaustive research.

All these innovations being made in the different BE sectors need to be funded somehow. The next graph (**Graphic 4.2.2.2.**) shows the source of these fundings.



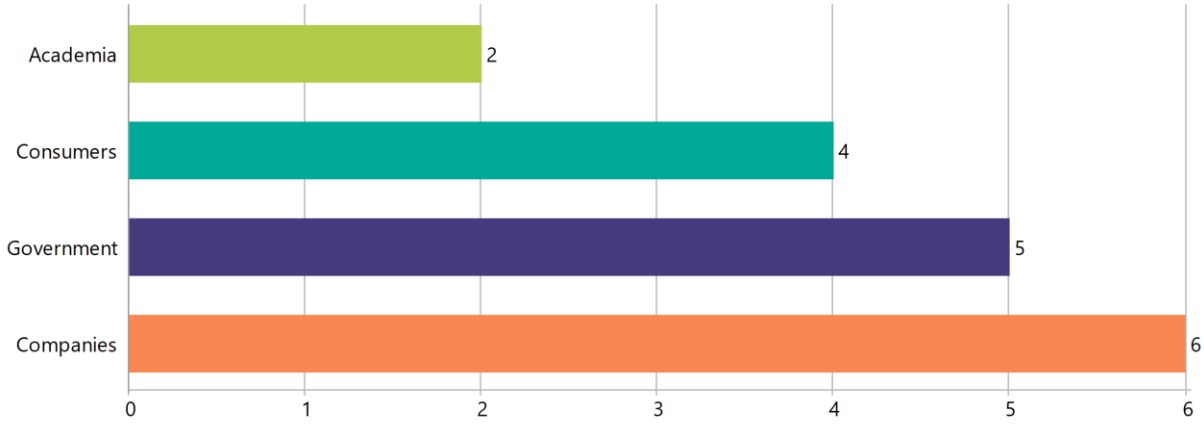
Graphic 4.2.2.2. Innovation funding

Source: self-elaboration through MAXQDA 2022

Most of the Portuguese companies analysed don't rely only on their income to fund their innovations, since only 14,3% of the sample (equivalent of one company) gets their funding through their income alone. The rest is either funded by own income and national/international

funds or just funds. An important conclusion can be retrieved from this statistic, which is the importance of national governments and the EU policies and funds to develop an innovative and sustainable BE.

Further in the interviews it was questioned who the key economic actors in the BE sectors (**Graphic 4.2.2.3.**) were.



Graphic 4.2.2.3. Economic actors

Source: self-elaboration through MAXQDA 2022

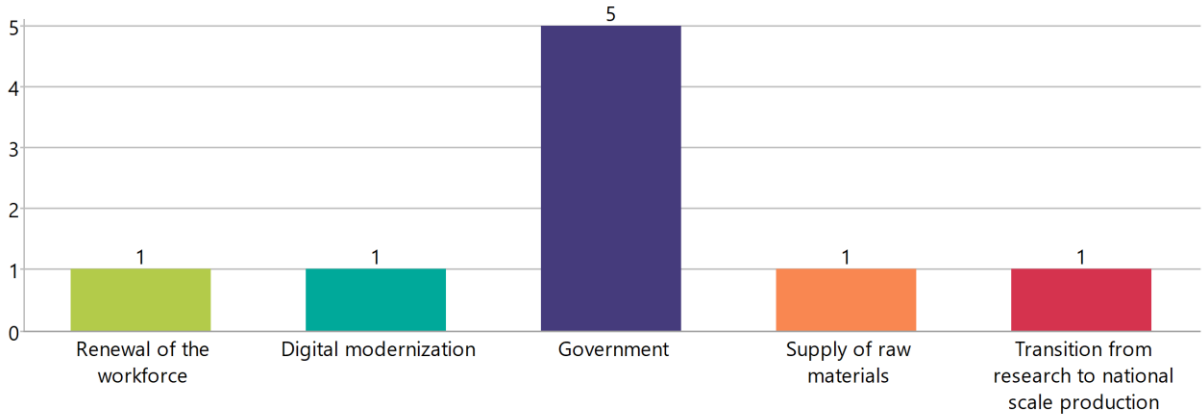
Considering different sectors have different specificities, however their opinion is uniform. They consider that the companies themselves and the government are the key economic actors in the blue economy. On one hand, some sectors might have a structure that does not necessarily influence them to make changes, such is the case of monopolies and oligopolies, where the government needs to interfere by regulating the market. On the other hand, companies have the responsibility to stimulate the economy overall. Furthermore, governments can support the companies and their sectors through the supply of subsidies and funds as it was represented in the previous graph (Graphic 5).

The consumers are, as well an important actor in any industry and economy since they are the ones that buy the end products and services. Although in a smaller proportion, academia is regarded to be important due to their theoretical research that supports any project that eventually is developed.

Despite focusing on some economic actors, most of the companies feel that there has to be a joint effort between all stakeholders.

4.2.3. Challenges and the future of the BE

Moving to one of the main objectives of this thesis the next graph (**Graphic 4.2.3.1**) describes what are the main barriers and challenges to the companies in the BE.



Graphic 4.2.3.1. Blue economy challenges and barriers

Source: self-elaboration through MAXQDA 2022

As demonstrated in the graph, one obstacle stands out, which is the government. According to the data collected, despite the differences between sectors, they all recognise that the government is a barrier for their development, namely the legislation, and the process of regulating new ingredients and additives for animal feed in the aquaculture sector. The ports companies indicate that the complex licensing and excess of bureaucracy discourage the private investment in the sector. The fishing sector defends that some EU policies that Portuguese government implement are not beneficial for the Portuguese companies, like the fishing limited quotas for some species.

Despite the overall opinion regarding the government, other difficulties were identified.

In aquaculture two challenges were identified, the supply of raw materials due to the fluctuation of prices and their availability, and the difficulty to make the transition from research to national scale production.

Being a more traditional industry, the fishing sector is composed by an older workforce that has been having difficulties in renewing their workers for younger people. The reason behind this, the interviewees believe, is due to the traditionality of the activity that does not attract the young generation. It is not a sector that is very digital friendly, at least yet, and the younger people don´t perceive the importance of the industry.

The last topic of the interviews was to understand how companies envision the future of the BE, and in this regard they all agree that it can only get better. They believe there has been a growing concern with the environment due to climate changes and it led to the increasing exposure of the BE sectors, who are seen as industries that are more sustainable and have huge unexplored potential.

It should be noted that since the sample was small, the interpretations regarding the sectors, may seem generalized in the author's description but are limited to the population analysed.

When comparing to the literature review this research found some common results. Regarding the key economic actors, there is an overall belief that all stakeholders have to work together to produce the desired results (Clark Howard, 2018, p.2). The joint effort between different stakeholders will improve the likelihood of successful development projects (Burgess, Clemence, McDermott, Costello, & Gaines, 2018, p.5).

The innovation in Portugal, as shown previously, is funded, in part by international funds which relates to the research conducted by some Portuguese authors (Fontes et al., 2019, p.3). The innovations being developed in Portuguese companies are a result of these national and European projects.

The obstacles to the development of the BE identified in this research, namely the government, were also referred to in the literature review, having been mentioned that there is a need to have stable and coherent policies and legislations to support the desired development (Keen, Schwarz, & Wini-Simeon, 2018, p.7).

When prospecting the future of the BE, the optimistic view of the companies in this research are aligned with Eikeset et al. conclusion that BE has the potential to lead a coordinated effort against climate changes (Eikeset et al., 2018,p.3).

Chapter 5

Conclusions, Limitations and Considerations

As it was indicated in the first chapter, the research problem was “how are Portuguese companies innovating and developing the blue economy industry?”. Throughout this research, especially in the last chapter, it can be discussed that Portuguese companies are indeed actively innovating and developing innovation practices. Their acknowledgement of the importance of having innovation departments, which have been developed in recent years, in most cases, and their public funding have been the engine behind the development of the BE industry.

The first objective of this research was: (i) the identification of the BE sectors being developed in Portugal. Although there are more blue economy sectors, as it was described in the literature review chapter (Eu, p.65-110), this research could only reach to 5 sectors, namely aquaculture, ports and maritime services, fishing, applied research, and shipyards. The limitation in this research’s sample can be explained due to the difficult availability of several companies contacted.

Another objective was: (ii) identification of the innovations being developed and implemented by the Portuguese companies in the different sectors. The innovations being developed, in the aquaculture sector, their focus has been trying to improve the quality of the fish they produce while preserving the fish health and the ecosystems where they thrive. They analyse different feed solutions, for example, different chemical compositions, and alternative protein sources and then apply it to the feeding processes. Developing alternative protein sources is common practice in aquaculture worldwide (EU, 2021, p.10).

Sectors such as ports, and shipyards develop technological innovations, investing in the digitalisation of their platforms to make them more efficient and sustainable. They are committing and partnering up with universities in sea research projects to better understand the ocean and its ecosystems. These projects are innovating maritime services such as the monitoring of the sea routes and deep ocean observation, the construction of more sustainable boats, and being facilitators for offshore wind energy projects. The results found on this research are according the findings other authors have mentioned before (Stevens et al., 2021, p13).

The other two sectors analysed are innovating through technological processes such as the electronical on-board auctions, for the fishing sector, and the development of products for different blue economy sectors, through applied research.

The third objective of this research was: (iii) identification of challenges and barriers that influence the development of the BE. Acknowledging the sectors analysed, the main obstacles identified were the lack of renewal of the workforce, especially in the fishing sector, but as well in ports and shipyards, and the intervention of the government, this one being consensual among all sectors. Portuguese companies feel that there is a very complex and unstable legislation in Portugal that restricts the development of the industry which is in accordance to (Keen et al., 2018,p7). The influence of the European Union policies is interpreted as having a negative impact (Hadjimichael, 2018, p3,4) and be disadvantageous for the national interests regarding the potential that Portugal sea has.

Lastly the fourth objective was: (iv) identification of the future prospects of the BE. It is the companies' belief that the future is going to be brighter for the blue economy sectors as they have high potential to fight climate changes and create a more sustainable future, if the different economical actors join forces, as it was supported by (Eikeset et al., 2018). However, and in agreement with (Ehlers, 2016, p.10) it is the companies' vision that this bright future can only be achieved through a coherent and general regulatory framework by the government. They need to create stable legislation and guarantee its effective implementation to support and boost the potential of the BE sectors.

5.1. Limitations and Considerations

There are some limitations in this research, mainly because the research is limited to only 7 companies, with only 5 sectors being represented.

The interviews were conducted only to one person, in a leading position. However, the author acknowledges that the results might be biased by the interviewees personal opinions and so, the results might not be used as a representative example of the Portuguese reality.

Despite its limitations mentioned above, the research can be considered to have relevant contributions, especially regarding the innovative processes being developed and the general perception of the practical obstacles that the different sectors face in a day-to-day basis.

This work is merely an addiction to an increasing exploration of the blue economy concept, specially the Portuguese case. It is the author's hope that this work helps to develop a more detailed research, including a more comprehensive number of Portuguese companies to further increase the knowledge of such an important subject. The increased knowledge and exposure of the BE would only be beneficial for the country and companies, because it would attract foreign investment which would fasten the development of these strategic sectors carrying the domestic GDP up.

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Appendix

Interview Script Directed to the Companies of the Portuguese Cluster of the Sea

Dear participant,

Thank you for contributing to the study of innovation practices in Portuguese companies in the blue economy sector, within the scope of my master's thesis in management at ISCTE Business School.

The data obtained will be treated anonymously, respecting the privacy of the companies, and will only be used for academic research activities.

Your participation is very important.

Note: In this research, the concept of Blue Economy is understood as the sustainable use of ocean resources for economic growth, improvements in livelihoods and employment, while preserving a healthy ecosystem.

Confidentiality commitment: The information obtained through this interview constitutes anonymous information to support this research. With your consent, the interviews will be recorded to facilitate data processing. The results obtained will be used only for academic purposes and published in the master's thesis and can be sent later by email to the participant.

All responses to the interview will be used solely and exclusively for the previously mentioned purpose.

(**Objectives:** 1 - Identify the BE sectors in Portugal; 2 - Identify and characterize the innovation practices of Portuguese companies; 3 - Identify the factors that contribute to the development of the BE; 4 - Identify the challenges of the different BE sectors for the future)

1. **Company characteristics**

Q1) Name?

Q2) Year of foundation?

Q3) Location?

Q4) What is the company's main activity?

Q5) How many employees does the company have?

Q6) How many did you have when it was founded?

Q7) What is the annual turnover (relative to the year 2021)?

Q8) What is the annual growth of the company in recent years (%)? (Last 5 years, for example.)

Q9) Which department do you work in the company?

Q10) What is the average level of education of your employees? Secondary Education, Bachelor's, Master's, Doctorate?

Q11) What are your main products/services?

Q12) What is your percentage of exports?

Q13) What is being done in your sector of activity to develop the blue economy/economy of the sea? What should be done, in your opinion?

Q14) How would you define the importance of your sector for the blue economy/economy of the sea?

Q15) Who are the main economic actors in the blue economy/economy of the sea?

Q16) What are the biggest challenges for the future of companies in the blue economy?

Q17) What are the main barriers to the development of your sector?

2. Innovation and sustainability

Q18) Does your company have an innovation department? If yes, when was it created and how many workers are assigned to it? If not, how is innovation carried out in the company?

Q19) What is the percentage of annual investment in innovation (average of the last two years)?

Q20) How is innovation financed: investment by the company itself, application to national or international support programs?

Q21) Have you already developed or are you developing some innovative products/innovative processes in your area?

Q22) Does your innovation department have any partnership with departments from other institutions? If yes, which ones?

Q23) In the innovation development process (if any), does the company consider aspects of sustainability? Which ones?

Q24) Is your company receptive to adopting innovations developed by other companies, assuming their efficiency (for example in terms of processes)?

Q25) Is your company involved in any national (eg PRR) or international (eg European funds) innovation project(s)? If yes, which ones?

Q26) What are the company's plans, in terms of innovation, for the near future?

Q27) How do your innovations contribute to the development of the sector in general?

Q28) In your opinion, how do you see the future of companies in the maritime economy?

Thank you for your participation and contribution to the investigation of the subject.