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THE BLUE ECONOMY:
A BETTER STEWARDSHIP OF OUR SEAS AND OCEANS
AS A LONG-TERM STRATEGY TO SUPPORT SUSTAINABLE GROWTH

RELATORE
Chiar.ma Prof.ssa *Francesca Spigarelli*

DOTTORANDO
Dott. *Gianluca Sampaolo*

COORDINATORE
Chiar.mo Prof. *Massimo Meccarelli*

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Introduction

Natural resource exploitation has been the main feature for economic development and trade for most of global history. At present, it is generally accepted that economic development around the world is leading to the irreversible depletion of natural resources, environmental degradation and consequent threat to future generations, which are key reasons and challenges for rethinking economic patterns. Environmental resources are considered today as economic assets and called "natural capital". This particularly holds true for the seas and oceans. Seas and oceans cover more than 70% of Earth's surface and are critical in ensuring that some of society's most basic needs are met. They hold 97% of all water and sustain 80% of all life forms on the planet. These vast ecosystems are amongst the world's largest carbon sinks, produce half of the oxygen we breathe and are the primary source of proteins for more than 3 billion people worldwide.

Seas and oceans are also the fabric of a large industry that raises environmental and social sustainability issues. These are at the heart of the United Nations (UN) Sustainable Development agenda for 2030 which is not compatible with a system focused on abuse and exploitation of the environment. Therefore, an efficient and sustainable management of oceans' natural capital is a critical policy objective for the economic process and progress. The growing awareness of the intense pressures that cause environmental degradation of the natural wealth highlights the need for a sustainable approach. Governance bodies established over the recent decades have defined tools and mechanisms to achieving a more sustainable development allowing the preservation and sustainable uses of the natural capital. At this stage of economy reframing, a new concept of "Blue Economy" (BE) has emerged to foster the shift towards a new, ocean (marine)-based sustainable economy.

BE has recently gained considerable policy and scholarly attention, in line with the expansion of its relevance on the political agenda beyond traditional economic sectors. BE implementation strategies are part of the UN's Sustainable Development Goals (SDGs), in particular SDG 14 "Life Below Water" which aims, among other things, to prevent and significantly reduce marine pollution, sustainably manage and protect marine and coastal ecosystems, minimize and address the impacts of ocean acidification, regulate harvesting by ending overfishing and illegal, unreported and unregulated fishing, conserve coastal and marine areas, increase scientific knowledge and transfer sustainable marine technologies.

As such, embedded is this quite a cutting-edge concept is the principle (and need) that ensuring economic growth and employment must go hand in hand with the imperative of protecting and restoring nature and fighting climate change. BE enables society to obtain value from the oceans and coastal regions, whilst respecting their long-term ability to regenerate and endure such activities

through the implementation of sustainable practices. This implies that human activities must be managed in a way that guarantees the health of the oceans and safeguards economic productivity, so that the potential they offer can be realized and sustained over time.

Both established and emerging, innovative sectors are part of the BE and offer important sources of sustainable economic development. The former include marine living resources, marine non-living resources, marine renewable energy, port activities, shipbuilding and repair, maritime transport and coastal tourism. The latter include ocean energy (i.e. floating solar energy and offshore hydrogen generation), blue bioeconomy and biotechnology, marine minerals, desalination, maritime defence, security and surveillance, research and education and infrastructure and maritime works (submarine cables, robotics). These sectors offer significant potential for the transition to a sustainable economic growth, as well as for employment creation. For instance, BE traditional sectors contribute to about 1.5% of the European Union-27 GDP and provide about 4.5 million direct jobs, i.e. 2.3% of EU-27 total employment. Emerging innovative BE sectors, such as ocean renewable energy, blue biotechnology, and algae production are adding new markets and creating jobs. This is without counting indirect and induced income and employment effects.

Against this backdrop, this dissertation has two purposes. Firstly, it provides a comprehensive overview of the current state of the BE in the world, highlighting challenges, opportunities, trends, and their potential for sustainable development. Secondly, it aims to provide a stocktaking tool based on solid foundation that will enable both policy-makers and stakeholders to make informed decisions to support relevant new initiatives and policies.

This dissertation has been developed within the Industrial Ph.D. program Eureka, financed by the Regional Government of the Marche along with ISTAO – The Istituto Adriano Olivetti, one of the oldest managerial schools in Italy which was founded in 1967 by the Economist Giorgio Fuà.

Chapter I of the dissertation is a literature review which fills the knowledge gap on how BE can represent an economic development model for institutions and entrepreneurs. It does so by adopting an exploratory approach for the collection and review of a series of scientific contributions to be considered as most significant and most relevant in addressing how the BE discourse is tied up in recent literature on economic development. Specifically, the exploratory approach was designed based on a set of criteria identified in compliance with the objectives of the investigation: 1) frame and evaluate the state of the art with regards to policies and initiatives undertaken at global level; 2) detect critical issues and challenges in the implementation of policies and initiatives; 3) identify policy implications and suggestions.

Chapter II contributes to the emerging literature on the development of a participative BE by presenting an innovative Quadruple Helix model, which not only connects domestic government,

academia, firms and users but acts as a driver boosting the foreign exposure of the country in this specific domain. The model is tested in Qingdao, an exemplary city included in the Blue Economic Zone of the Shandong Province, in China, through an exploratory approach based on desk research integrated with semi-structured interviews with eight experts.[1]

In Chapter III, the Chinese response to the UN's "Decade of Ocean Science for Sustainable Development 2021-2030" is unfolded based on documentary analysis of official planning and strategic documents. The ocean is considered of great significance by Chinese political leaders to the survival and development of human society. Accordingly, since the launch of the "Ocean Decade", which represents an important UN resolution to promote sustainable ocean development as well as the most important initiative in the coming decade that will exert a far-reaching impact on the progress of marine science and global marine governance, various initiatives have been undertaken by China in order to uphold its cooperation-based commitment to the ecological protection of oceans.

Chapter IV makes the case for the shipbuilding industry in the Marche Region, in Italy. The importance of the Marche Region in the shipbuilding industry, suggested a more in-depth exploration to understand what impact the positive performance of the sector can have on the regional industrial system and how it could represent a catalyser for the system of highly qualified and technologically advanced supply chain. In writing this contribution, which was carried out together with colleagues from ISTAO on behalf of Fondazione Marche, I had ample recourse to the latest studies on the shipbuilding industry and carried out a survey investigating the sector in depth. Semi-structured interviews with top management of the most representative regional shipyards and a sample of subcontractors and companies were conducted to witness the growth of the industry. The results of the analysis provide interesting insights for policy-making to support the development of the regional shipbuilding industry and supply chain.

[1] This Chapter was published as a paper in the journal *Environment, Development and Sustainability*: https://doi.org/10.1007/s10668-021-01378-0.

Chapter I

The Blue Economy Discourse: a Review of Key Literature on Existing Policy Narratives for a New Economic Development Paradigm

1.1 *Introduction*

Governance of ocean and marine resource use is increasingly facilitated around a recently introduced term and concept – "Blue Economy" (BE) or "Blue Growth" (BG). Building directly on the efforts of the 4th United Nations Conference on Sustainable Development "Rio+20" in 2012 that advocated a 'green economy' perspective, this concept is essentially the newest of many recent calls for more holistic management of complex marine social-ecological systems. It refers to economic growth within the marine sector that does not lead to the degradation of marine ecologies (Eikeset et al. 2018). While it is beyond the scope of this work to discuss in detail the inter- and transdisciplinary implications of existing conceptualizations of BE/BG, or the innate conflict among different industries even when the concept formally includes a reference to 'sustainable use of the seas' (see e.g. Burgess et al. 2018; Voyer et al. 2018), it is useful to review how the discourse is tied up in recent literature on economic development. The hope is that that those reading this contribution will gain a better understanding of the various definitions, as well as a heightened awareness of the policies, constraints of, and possibilities within, the concept. More awareness hopefully will lead to enhanced communication among colleagues and across disciplines and to the convergence towards an operational definition of BE/BG necessary to create comprehensive science-based policy that delivers net social and economic benefits as well as benefits the aquatic environment, in particular marine systems. To this regard, the purpose of this contribution is to fill the knowledge gap on how BE/BG can constitute an economic development model for institutions and entrepreneurs. The results presented are derived from the collection of key academic literature and scientific contributions to frame and evaluate the state of the art with regards to policies and initiatives undertaken at global level. The remaining article is organized as follows. Section 1.2 and section 1.3 build a theoretical framework on the value of the ocean and on the historical roots and definition of the concept. Section 1.4 presents the data sources and the methods adopted for the collection of key literature. The state of the art of unfolding policy developments and directions in BE/BG is then offered in section 1.5. The discussion in section 1.6 addresses the critical issues emerged while providing policy suggestions and implications in section 1.7. The contribution concludes with some final remarks and future research direction in section 1.8.

1.2 *The Ocean Value*

What are our feelings when we reach the sea shore: a limitless expanse of water, you can see as far as the horizon, and somehow beyond it. The ocean seems to be the last frontier, as John Milton felt more than 300 years ago when he wrote "Paradise Lost":

"*A dark*
Illimitable ocean without bound,
Without dimension, where length, breadth, and highth
And time and place are lost (Milton 1674)."

274 years later, Shepard (1948) observed that "Man's perpetual curiosity regarding the unknown has opened many frontiers. Among the last to yield to the advance of scientific exploration has been the ocean floor. Until recent years much more was known about the surface of the moon then about the vast areas that light beneath three-fourths of the surface of our own planet". This statement continues to hold true and is repeated by scientists countless times (see for instance Fernàndez Otero et al. 2019). Arguably, nowhere on Earth have science and technology so strongly driven economic development as in the seas and the oceans, and this inter-relationship continues to drive new economic activity (OECD 2016).

Human beings have an extremely complex, interconnected and inseparable relationship with the ocean. From the spread of human groups in early prehistory to the importance of container shipping and maritime commerce to modern economies today, sea travel has remained central to the development and maintenance of human societies. As reported by Henderson (2019), it seems odd then that it enjoys, at best, a supporting role in dominant historical narratives. In such narratives, it is common to read about the industrial and agricultural revolutions with little or no mention of the vital seafaring revolution that took place long before them (Wells 2006; Hart-Davis 2006; Black 2018). In this modern age of air travel, it is perhaps all too easy to underestimate the role of the sea. It is somewhat ironic that as global sea levels continue to rise, an awareness of the sea as a driver of human change and development has fallen at a similarly dramatic rate. This may seem odd given the importance of the sea to human life and development but it reflects a long held, and hard to break, conceptual division between land and sea prevalent globally in academia, legislation, government and public perception (Henderson 2019).

Henderson (2019) informs that the separation of land and sea as conceptual and physical entities may seem to be one of the most basic and non-problematic divisions of the natural world but it is ultimately responsible for the underappreciated role of the importance of the sea in human history. Terrestrial heritage takes precedence and is dominant in historical narratives, while marine and

underwater heritage is usually regarded as supplemental and optional. Notably, the author adds that despite the fact that pioneers such as George Bass (1996) recognised from the outset that maritime archaeology should not be viewed as a separate subject or distant cousin to archaeology carried out on land, it is still widely regarded as an exotic add-on to 'mainstream' terrestrial research.

Archaeologists continue to be labelled 'underwater' or 'maritime' archaeologists if their research involves work in the sea, the implication being that maritime archaeology is something apart from the archaeological 'mainstream' on land – something glamorous and adventurous but not fundamental to the discipline, something not to be taken too seriously. Although it should be self-evident that studying past human interaction with the sea is vital to the human past as a whole, the majority of universities still offer no, or at best limited, provision in maritime archaeology. Equally, the capacity for nations to fully record, study and protect their marine heritage through professional services remains far behind that of terrestrial capacity, especially in developing countries and Small Island Developing States (SIDS) where the threats to that heritage are often more intense (Henderson 2019).

More recently, the United Nations Environment Program in its report under the rubric of 'Green Economy in a Blue World' compares the resources of ocean as 'cornucopia' for human civilization (UNEP 2012). Here, the term cornucopia is a Greek mythical lexicon that refers to cone shaped ornament which is abundant with whatever its owner desires. Hence, there has been brewing global concerns for preservation and sustainable utilization of ocean resources. For centuries, the practical usage of ocean was few confining to coastal fishing, commercial voyages and naval battles for the expansion of empire. Consequently, the maritime affairs in preceding centuries was special concern of only handful of seafaring nations, and thence, the nature and contents of the law of the sea was determined largely by the dominant interests of the maritime powers.

1.2.1 *Data from the Ocean*

Life originated in oceans which constitute more than 95% of biosphere, cover 71% (two-thirds) of the planet's surface and contains 97% of the planet's water, yet more than 95% of the underwater world remains unexplored (OECD 2016). The ocean without caring what we do towards its wellbeing, it continues to support all lives by generating oxygen, absorbing carbon dioxide, recycling nutrients and regulating global climate & temperature. From that perspective, blue waters of the oceans are deemed as the bloodstream of this planet earth. Without it, pure thrombosis would occur to human civilization. Our very survival as a species is dependent upon healthy oceans and seas as they drive many features of life on Earth.

A wide range of ecosystem services (ES) are underpinned by the world oceans' and seas' high biodiversity. These ES services provide for significant economic and social value including: they make the planet habitable, provide half of the world's oxygen, contain 80% of life on the planet, regulate climate, provide coastal protection, provide cultural services including coastal tourism, provide water, nutrients, chemicals, and store carbon dioxide (FAO 2017; McKinley 2019). They are supplier of major food source: seafood, which is the primary source of animal protein upon which the diet of more than 3.1 billion people (60% of the planet's human population) depend to provide at least 20% of their daily protein intake, and they directly support the livelihoods of 10% to 12% of the world's population (FAO 2017). As highlighted by the OECD report "*The Ocean Economy in 2030*" (2016), seafood products account for 10% of total agricultural food exports and 1% of world merchandise trade in terms of their value; the shipping industry carries approximately 90% of global trade; and the tourism industry, of which marine and costal tourism is a measure of part, represents 5% of global GDP; finally, more than 500 million people are engaged in ocean related livelihoods (UNDP-GEF 2012).

As global economies continue to recover from a significant period of instability and uncertainty, what has become evident is that, increasingly, we are looking towards the sea to support growth, stability, development and for an ever-growing range of resources (fisheries, energy, recreation, and tourism) (McKinley 2019). The ocean economy of the next 20 years or so is being driven primarily by developments in global population, the economy, climate and environment, technology, and ocean regulation and management (OECD 2016). More than 40% of the global population inhabiting the coastal areas (UN 2009). Population growth, urbanization and coastal development are at the heart of growth in the ocean economy. With an ever-growing population and uses of land areas reaching their limit, it is timely to focus on the ocean to solve some of the world's major issues such as security of food, water supply and energy. By 2050, an extra 2 billion people at least will need to be fed, raising demand for fish, molluscs and other marine foods from fisheries and aquaculture; as consumers they will stimulate sea-borne freight and passenger traffic, shipbuilding and marine equipment manufacturing, as well as exploration for offshore oil and gas reserves. Ageing populations will continue to target coastal locations for holidays, cruise tourism and retirement homes, and motivate the medical and pharmaceutical communities of the world to accelerate marine biotechnological research into new drugs and treatments (OECD 2016).

Significant areas of the ocean remain unused and can potentially provide opportunity for economic growth and resource use. As Dalton et al. (2019) note, the demand for ocean resources is an important driver of economic growth. It provides natural resources, access to trade, and opportunities for leisure activities and has the potential to become an important source of clean energy

and marine products. Data from the OECD (2016) confirms this trend: ocean-based industries contributed some 31 million direct full-time jobs in 2010, around 1% of the global workforce and about 1.5% of the global workforce actively employed. In 2030, in the business-as-usual scenario they are anticipated to employ over 40 million people, broadly unchanged over 2010 at more than 1% of the global workforce (of around 3.8 billion) (OECD 2016).

Focusing on the European continent, Europe's 89,000 km coastline along two oceans and four seas strongly influences the lifestyle, wealth, and public wellbeing of its citizens (Zanuttigh et al. 2015). The maritime economy accounts for as much as 5% of the total European economic activity, leading to almost 40% the European Union's (EU) Gross Domestic Product (GDP). European fisheries and aquaculture employ 0.7 million people and generate more than 30 billion Euros a year. European aquaculture alone has an annual production of 2.5 million tons. Components derived from marine organisms through biotechnology are already being used in food, pharmaceutical, cosmetic and chemical industries. 90% of the EU's external, and 40% of its internal trade are carried out by maritime transport, with 1200 ports, managing 3.5 billion tons of goods, and 350 million passengers per year. The unexploited potential of the marine ecosystem is very large, since it is estimated that more than 90% of the marine biodiversity remains unexplored, offering a huge potential for discovery of new species and applications derived from biotechnologies, which is foreseen to generate 10% annual growth for this sector (Zanuttigh et al. 2015).

In the Mediterranean region, tourism activities are connected with a variety of recreational and business purposes and are mostly coastal oriented with dramatic increases during July and August (Soukissian et al. 2019). As reported by Soukissian et al. (2019), Mediterranean tourism offers 11% of total employment and contributes by 11% to the regional GDP, according to the World Travel Tourism Council (2015); and the Mediterranean area is a favorable destination in terms of both international and domestic tourism (more than 300 million international tourist arrivals), with a forecast of 500 million by 2030, as it is noted in Fosse and Le Tellier (2017). Moreover, fishing industry provides about 220,000 jobs (employed on fishing vessels) and is therefore considered a main pillar of the Mediterranean economy (FAO 2016).

As concerns maritime transportation, from time immemorial, the oceans have been transport routes of vital importance. It is impossible to imagine a world economy without maritime transportation as the driving belt for a globalized commerce (Ehlers 2016). More than 95% of the intercontinental trade of goods and 40% of trade within the EU rely on maritime transportation. About 55,000 commercial vessels ply the oceans, with a transport volume of 10 billion tons (Verband Deutscher Reeder 2014). The recently published review from the United Nations Conference on Trade Development (2018), highlights the significance of the maritime transport. Board ships are the

main mean of transport, carrying 80% of global trade by volume that subsequently is being handled by seaports. As it is reported by Soukissian et al. (2019) hundreds of these activities are taking place in the waters of Mediterranean Sea and therefore maritime transport presence is intense in the area (Piante and Ody 2015). Also, some indicative and self-explanatory numbers, regarding maritime sector in the area of MS, could be the 550,000 direct jobs provided and the noteworthy participation of 21 ports in the list with the 100 world top ports (Soukissian et al. 2019).

1.3 *Historical Roots and Definition of Blue Economy and Blue Growth: an Overview*

The first proposal for a Blue Economy is generally attributed to Gunter Pauli in his book "*The Blue Economy. 10 years – 100 innovations – 100 million jobs"* (2010). Interestingly, the concept was not initially intended to relate specifically to oceans or inland waters, rather the term "Blue Economy*"* was used to reflect an evolution and refinement of the 'green economy' concept.[2]

In terms of policy history, the roots of the Blue Economy (hereinafter referred to as BE) and Blue Growth (hereinafter referred to as BG) concepts can be traced back to the conceptualization of Sustainable Development (SD). SD – or the challenge of a sustainable use of natural resources, while at the same time securing economic and social objectives – has been a focus on international community since 1960s (Eikeset et al. 2018). Building on Eikeset et al. (2018) and (Najam et al. 2003), three large international conferences mark the main milestone in the development of the SD concept:

- 1st UN conference on SD in Stockholm 1972 defines the environmental/resource dimension;
- 2nd UN conference on SD in Rio 1992 defined the economic dimension;
- 3rd UN conference on SD in Johannesburg 2002 defined the social dimension;
- 4th UN conference on SD, Rio+20 in 2012 at the backdrop of the global financial crisis a new concept emerged: "green growth".

Green growth stands for fostering economic growth and development while ensuring that natural assets continue to provide the resources and environmental services on which our well-being relies on, according to the OECD (2011). Realizing the great traction of this new concept and the close relation with the growth derived from terrestrial ES, a group of SIDS stressed the importance of the BE – the multifaceted economic and social importance of the ocean and inland waters – and the importance of BG (Eikeset et al. 2018).

At the Rio+20 UN conference, the FAO sent the very strong message that healthy ocean Ecosystem Services (ES) ensured by sustainable farming and fishing operations was a prerequisite

[2] For further details see: http://www.theblueeconomy.org/blue/Home.html.

for a BG. Since the Rio+20 UN conference, the BG concept had been widely used and became important in aquatic development in many Nation States, regionally as well as internationally (Eikeset et al. 2018). These will be specifically addressed in 1.5.

Apparently, the two terms – BE and BG – can be used interchangeably. However, a distinction has to be made based on how they referred to in policy planning documents and in the literature. BE means the use of sea and the use of its resources for sustainable economic development and the concept is new. Bari (2017) refers to it as the decoupling of socio-economic activities and development from environmental degradation and optimizing the benefits which may be derived from marine resources. The attitude of achieving long-term prosperity by a country or a region befitting the wellbeing of all citizens and the mankind preserving the environment, especially the sea is the basis of the BE (Bari 2017). According to the European Commission, the EU's BE represents 5.4 million jobs and a gross value added of just under EUR 500 billion per year (European Commission 2012). While BG is the long term strategy to support sustainable growth in the marine and maritime sectors as a whole. Seas and oceans are drivers for the European economy and have great potential for innovation and growth. It is the maritime contribution to achieving the goals of the Europe 2020 strategy for smart, sustainable and inclusive growth. Nowadays, maritime industry is recognized as a significant part of economy. And as everyone is striving for economic growth, a new magic word has been created: Blue Growth (Ehlers 2016). Indeed, the seas and oceans have the potential to be a major source of new jobs and growth. Thus, BG is the creation of economic activity and jobs at sea, while multiple use of space makes efficient use of the available sea area by combining industries. Clearly there are many combinations and many value propositions. However, most technologies to date are considered blue sky concepts, with little robust techno-economic analysis demonstrating profitability (Dalton et al. 2019).

At present, BE, as the new development concept and the "blue engine," is becoming an important driving force for achieving global sustainable development. Environmental observations play a powerful technical supporting role in realizing blue economy development (Wenhai et al. 2019). BE recognizes the ocean realm as the newly inducted platform of ocean development as well as ocean governance. The concept mirrors the dragging line between socio-economic development and reckless environmental degradation (Smith-Godfrey 2016). It is a science intensive maritime concept (Gamage 2016). Scholars belonging to maritime domain are used to illustrate BE in inclusive manner encompassing marine environment, maritime economic and trade activities (Smith-Godfrey 2016). However, it is pertinent to mention here that at present, a universally accepted definition of blue economy has yet to be formulated (Patil et al. 2016; Eikeset et al. 2018; Voyer et al. 2018).

According to the World Bank, the concept BE delineates such marine based economic development which at the same time spearheads the human wellbeing and social equity in tandem with decreasing the potential environmental harm and ecological scarcities (Patil et al. 2016). The Economist magazine in its report, under the title of *The Blue Economy: Growth, Opportunity and a Sustainable Ocean Economy* explains BE as 'sustainable ocean economy'. A salient feature of such sustainable ocean economy requires the usage of balanced economic activity in the ocean realm which would enable the marine ecosystem to remain resilient and healthy (Goddard 2015). The Indian Ocean Rim Association (IORA), a vibrant regional forum of littoral states of the Indian Ocean, defines blue economy as the integration of ocean economy development that enhances human welfare in a holistic manner. In the definition of the IORA, the concept ocean economy development encompasses the practices of social inclusion, environment sustainability and innovative business model (Gamage 2016).

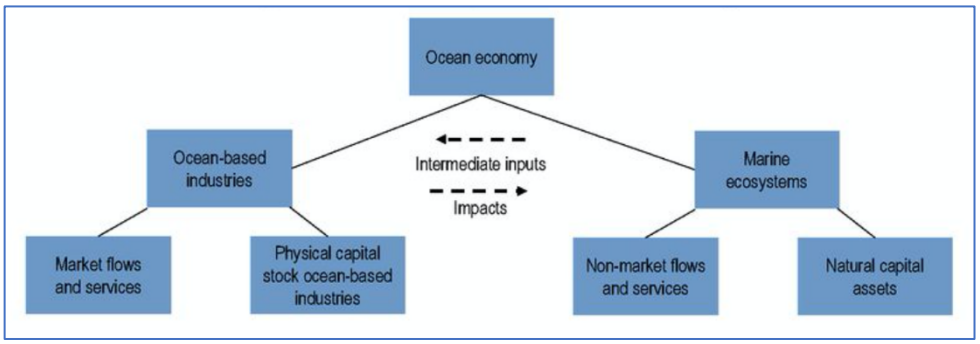
The terminology relating to the ocean economy is used differently around the world. Commonly used terms include: Ocean industry, Marion economy, marine industry, marine activity, maritime economy and maritime sector. Park (2014) observes that "Ocean" is usually used in Ireland and the US States, whereas "marine" is widely used in Australia, Canada, French, New Zealand and the UK. "Maritime" is frequently used by the EU, Norway and Spain. Often terminologies are also translated differently into English when they are taken from Japanese, Korean or Mandarin. "Marine" is the preferred adjective here as it relates to all things pertaining to the sea and as such encompasses all activity associated with the oceans while "maritime" is usually used in a more restricted sense to refer to sea travel, shipping and exploration. "Marine" also fits in with the terminology used in the Ocean Sciences and by marine stakeholders in spatial planning, conservation, tourism, ecological services, engineering and development more generally (Henderson 2019). In accordance with the OECD report (2016), the present section will endeavor to distinguish "maritime" and "marine" as follows: "maritime" will be understood as being connected with the sea, especially in relation to seafaring, commercial or military activity", while "marine" will be understood as "of, found in, or produced by the sea, 'marine plants'; 'marine biology'". While "industry" embodies only market-based activities in the private and public sectors, the term "economy" is better sweet to capturing the notion of both market-based and non-market goods and services.

In addition to the differing terminology, there is still no universal excepted definition of the ocean economy (Eikeset et al. 2018). For example, for the European Commission, the maritime economy consists of all the sectoral and cross sectoral economic activities related to the oceans, seas and coasts (ECORYS 2012). This includes the closest direct and indirect supporting activities necessary for the functioning of these economic sectors, which can be located anywhere, including

in landlocked countries. A similar definition is suggested by Park (2014), after conducting a meta study about existing different worldwide definitions and perception of the ocean economy: "The ocean economy are the economic activities that take place in the ocean, receive outfits from the ocean, and provide goods and services to the ocean. In other words, the ocean economy can be defined as the economic activities that directly or indirectly take place in the ocean, use the ocean's outputs, and put the goods and services into the ocean's activities."

In accordance with the OECD report (2016), this section will consider that any definition of the ocean economy is incomplete unless it also encompasses non-quantifiable natural stocks and non-market goods and services. In other words, the ocean economy can be defined as the sum of the economic activities of ocean-based industries, and the assets, goods and services of marine ecosystems. Figure 1, retrieved from the OECD report (2016) summarizes this concept. Ocean-based industries can be divided into market flowers and services and physical capital stock of the industries. Marine ecosystems represent natural capital and non-market flows and services. In many cases, marine ecosystems provide intermediate inputs to the ocean-based industries. An example is coral reefs. They provide shelter in habited for fish nurseries and unique genetic resources, while at the same time providing recreational value for maritime tourism. Conversely, ocean industries can impact the health of marine ecosystems, e.g. through discharge if ship waste or pollution from oil spills (OECD 2016).

Figure 1: The concept of the ocean economy.



Source: OECD 2016.

It is conspicuous in studies of the ocean economy that the sectoral scope of the ocean economy varies rise considerably by country. The number of categories chosen can range from 6, as in the case of the US, to 33 in the case of Japan. Some industries may be excluded from the ocean economy in one country but not in another. Moreover, there are significant differences among countries in the delineation of the classifications and categories used. Nationally agreed definitions and statistical terminology for ocean-based activities, do not yet exist (Park, 2014).

In order to drag a line between the two concepts BE vs BG, the economy of the sea can be divided in two:

- the mature BE industry sectors; and
- the emerging innovation of the BG sectors (Dalton et al. 2019).

The global value of the established BE is enormous. In the report *The Ocean Economy by 2030*, the OECD (2016) estimates that the global gross value added (GVA) of the whole BE in 2010 was recorded at about US$1.5 trillion when it was dominated by the established industries of offshore oil and gas (34%) and maritime tourism (26%). Ship transport and shipbuilding accounted for 9% with a further 13% attributed to port activities and 11% for marine equipment. Catch fisheries featured at only a 1% share of the ocean economy with a further 5% in fish processing (OECD 2016).

By 2030 in the ocean economy "business-as-usual scenario", it is estimated to grow to more than US$ 3 trillion (at 2010 prices) and maintain its share of world total GVA (projected to reach about US$ 120 billion by 2030) about 2.5% of total global GVA (OECD 2016). Maritime and coastal tourism, including the cruise industry, is expected to take the largest share (26%), followed by offshore oil and gas exploration and production with 21% and port activities with 12%.

To compare an industry's contribution to the economy across countries, the share of the total GVA is preferred to the share of GDP. The System of National Accounts (SNA) recommends using GVA at basic prices for this purpose (OECD 2016). The difference between total industry GVA and total GDP is taxes less subsidies on products, which varies across countries. This adjustment is made at the aggregate (total economy) level because, while time series of taxes less subsidies on products may be available by product, they are not generally available by industry (OECD 2016).

However, the OECD (2016) consider these estimates highly conservative. First, they do not yet include a good number of ocean-related sectors for which adequate data are presently not available. Second, they understate activity in certain sectors (such as shipping) for which numerous countries have had to be excluded due to lack of data. Third, the modest growth expected in some large industries (e.g. offshore oil and gas) masks comparatively high rates of growth expected in others (e.g. marine aquaculture, offshore wind, fish processing, port activities) and holds back overall average growth in the ocean economy as a whole.

These results suggest that many parts of the ocean economy have the potential to outperform the growth rate of the global economy as a whole. Indeed, such a conclusion is supported by a substantial number of sector specific forecast and projections conducted by a host of international organizations and agencies, industry associations and research institutes. They indicate strong growth in volume terms over the coming 15 years in shipping, shipbuilding and repair, port activity, marine

supplies, marine aquaculture, offshore wind and marine tourism. They expect less strong growth in capture fisheries and offshore oil and gas. Ocean renewable energy, marine biotechnology are also considered to possess considerable potential, the scaling-up of which, however, is unlikely to happen before 2030 (OECD 2016).

It is recognised that two of the four traditional mature BE sectors (catch fisheries and offshore oil and gas) have reached peak capacity and are in decline. Shipping continues to grow along with growth in global trade and tourism continues to expand along with disposable income in emerging economies. However, the BG innovation sectors are targeted in policy to be the main drivers of the new maritime economy (Dalton et al. 2019). However, as reported in the OECD report (2016), the new BG industries are currently minimal, with only aquaculture and offshore wind showing at less than 1% each. Offshore wind shows the most energetic growth to 2030, rising to 8% of the whole (OECD 2016).

But, what to understand by BE in Europe? First of all that covers what may be called the traditional maritime industry: maritime transportation as the core of maritime industry, including port services and shipbuilding, as well as fisheries, and also the exploitation of oil and gas from the seas. These sectors are still gaining in importance (Ehlers 2016). At the heart of maritime uses are fisheries, which have been pursued on an industrial scale worldwide for a long time now. Fish is indispensable to provide food high in protein. Around eighty to ninety-seven million tons of fish are captured annually in marine fishing areas (FAO 2020). An important sector is the exploitation of oil and gas from the sea which has been practiced since decades; therefore, it is already a traditional part of maritime industry. Today, North Sea production, for example, still covers a considerable part of Europe's energy demand (Ehlers 2016).

However, traditional maritime industry is more and more supplemented by new economic areas. The European Commission has identified five sectors with a high potential for growth (European Commission 2012):

- Aquaculture;
- Coastal and maritime tourism (blue tourism);
- Marine biotechnology (blue biotechnology);
- Ocean energy (blue energy);
- Seabed mining.

Aquaculture, a close relative of fisheries, is the world's fastest growing sector in the food producing industry. It covers not only the production of fish and shellfish but also aquatic plants and it already provides the planet with about half of all the fish we eat. The EU is the fifth largest producer

worldwide, accounting for about 3.3% of global fisheries and aquaculture production. 80% of this production comes from fisheries and 20% from aquaculture. Aquaculture is a significant activity in many Member States, producing around 1.3 million tonnes in volume and more than EUR 5 billion in value. Of total world aquaculture production, the EU occupies a share of 1.23% in terms of volume and 2.29 % in terms of value. Mediterranean mussels make up around a quarter of the total volume farmed in the EU, while Atlantic salmon and rainbow trout together represent just under a third of the total value. The main aquaculture-producing Member States in terms of volume are Spain, the UK, France, Italy and Greece (European Commission 2020). Aquaculture employs roughly 75,000 people, including part-time and full-time jobs in both marine and freshwater aquaculture (European Commission 2020).

Coastal and maritime tourism though often overlooked, when speaking about maritime industry, is the largest single maritime economic activity in Europe (Ehlers 2016). In particular, open water activities, namely yachting as well as the cruise industry, are steadily increasing. About 48 million EU citizens participate regularly in water sports, out of which 36 million participate regularly in boating activities. Over 4,500 inland & coastal marinas create up to 70,000 jobs and generate up to 4 billion euro of annual turnover. About 6 million boats are kept in European waters out of which 60,000 charter boats generate up to 6 billion euro of turnover each year (European Commission 2017). The blue tourism sector employs almost 3.2 million of people and generates a total of 183 billion euro in gross value added per year representing one third of the maritime economy (ECORYS 2013; European Commission 2014).

Compared to tourism, blue biotechnology still is a small niche market for Europe with a gross value added of less than 1 billion euro though some remarkable success stories may already be noted (European Commission 2012). Less conservative predictions of an annual growth of up to 12% reveal the high expectations for further developments as marine organisms attract more and more attention in order to develop new products, in particular not only for pharmaceuticals and cosmetics but also for food, feed, and the chemical industry (European Science Foundation 2010). Research has focused on marine microorganisms as a nearly inexhaustible source of novel biological agents, also including the production of bio-energy (European Commission 2012). Subject to further technological breakthroughs, blue biotechnology will become an emerging market offering great potentials of marine aquatic products (Ehlers 2016).

Marine renewable energy including both offshore wind power and ocean energy will increasingly contribute to meet our energy demands and to reduce greenhouse emissions (Ehlers 2016). Until now, the expansion of renewable energies, such as wind and solar power, has mainly taken place onshore. The energy in the oceans has remained largely untapped. But things are

changing. The production of environmentally friendly energy from the oceans is now being promoted worldwide. Expectations are high. It is hoped that wind, waves and ocean currents will meet a substantial share of the world's electricity needs (World Ocean Review 2010). The oceans are unretrieved treasure troves since are teeming with energy. Tidal forces move immense masses of water. Strong winds build up mighty waves. According to the World Ocean Review (2010), almost 90% of global wind energy is contained in the turbulence above the world's oceans. Wind, waves and currents together contain 300 times more energy than humans are currently consuming. For a long time, this abundance went untapped. In recent years, however, we have begun to harness this energy. The first offshore wind farms were built. Hundreds of power plants have been and are being built to convert ocean current and wave energy to electricity. The key renewable marine energies are summarized by the World Ocean Review (2010):

- Wind energy;
- Wave energy;
- Tidal energy;
- Ocean current energy;
- Energy derived from temperature differences at various ocean depths (ocean thermal energy conversion – OTEC);
- Energy derived from the different salt content of freshwater and saltwater (osmotic power);

Experts estimate that offshore wind power could in future supply 5000 terawatt-hours (TWh) of electricity worldwide per year (World Ocean Review 2010). Ehlers (2016) argues that offshore wind farms are rapidly expanding. The total installed capacity in Europe is projected to produce approximately 14% of the EU's total electricity consumption by 2030 (European Commission 2012). However, wind energy is only a partial aspect. An even more interesting aspect is the technological challenge of exploiting the almost unlimited energy resources of the oceans by making use of tidal streams, waves, and currents as well as of differences in temperature or salinity (World Ocean Review 2010). Although the technological developments are still at an early stage and require a lot of technological improvement and innovation, the first plants have been put into operation (Ehlers 2016). Various tidal power stations exist already all over the world, especially in South Korea, France, UK, Scotland, and Canada (Power Technology 2020). The global potential of wave energy is estimated at 11,400 TWh per year (World Ocean Review 2010). Ocean current energy can also be harnessed using submerged rotors which are driven by the motion of the water. It has been estimated that ocean current power stations and tidal power plants together could harness several 100 TWh of electricity per year worldwide (World Ocean Review 2010). Ocean thermal energy conversion

(OTEC) utilizes the temperature difference between warm surface water and cold deep water to generate power. In order to drive the steam cycle in an OTEC power station, the temperature difference must be at least 20 degrees Celsius. The technology is therefore more suited to warmer marine regions. The warm water is used to evaporate a liquid which boils at low temperatures, producing steam which drives a turbine. Cold seawater (4 to 6 degrees) is then pumped up from a depth of several 100 metres and used to cool and condense the steam back to liquid form. However, until now the cost of OTEC technology has been considered prohibitive, requiring pipelines of several 100 metres in length and powerful pumping systems (World Ocean Review 2010). Finally, the osmotic power plant is an entirely new way of generating energy. It exploits the osmotic pressure which builds up between freshwater and saltwater when they are pumped into a double chamber and separated by a special semi-permeable membrane. The technology is still in its infancy. In 2009, however, members of a Norwegian syndicate constructed the world's first osmotic power station on the Oslo Fjord. The plant is designed principally to develop this technology, at present generating only a few kilowatts of electricity. However, the sustainable global production capacity of osmotic power could in future amount to 2000 TWh annually (World Ocean Review 2010).

In the past, seabed mining concentrated on the offshore exploitation of oil and gas. This industry is still growing, as the consumption of fossil fuels will further increase. It is estimated that one quarter of the oil reserves are to be found in offshore areas. Offshore oil and gas production currently counts for more than one third of the worldwide production (World Ocean Review 2010). Extraction activities are expanding to depths of 2000 m and more and to remote areas with fragile ecosystems, including regions covered by ice (World Ocean Review 2014). Scientific studies suggest that 30 % of undiscovered gas and 13% of undiscovered oil can be found in the Arctic Region (World Ocean Review 2010; World Ocean Review 2014).

As concerns mineral resources, sand and gravel have been extracted from shallow coastal seas already for a long time. As Ehlers reports (2016), current mining activities also include diamonds off the coast of South Africa and tin, titanium, and gold along the shores of Africa, Asia, and South America. The increasing request for raw materials encourages new commercial activities to exploit mineral resources from the deep-sea floor, targeting polymetallic nodules and sulfides, cobalt-rich crusts, and rare earth element-rich deep sea sediments (European Commission 2012). Various exploration projects are on their way, partly within the EEZ area, partly on the high seas, the so-called Area where an authorization of the International Seabed Authority is required (UN 1982). It is expected that in the coming years, first exploitation activities will start. Quite optimistically, the European Commission estimates that by 2020, 5% of the world's minerals, including cobalt, copper, and zinc, could come from the ocean floors; this could rise to 10% by 2030 (European Commission

2012). Accordingly, the annual turnover of marine mineral mining may grow from virtually nothing to 10 billion euro by 2030 (European Commission 2012). But, prior to that, major technological challenges need to be overcome. Ehlers (2016) argues that what the European Commission has not included in its considerations are gas hydrates which are an ice-like solid mixture combined of water and methane gas. They are widespread in marine sediments primarily on the continental margins. Recent estimates of the worldwide amount of gas hydrates vary between 500 and 1500 gigatonnes (Gt) of carbon, whereas the conventional reserves of natural gas are estimated at 100 Gt (World Ocean Review 2014). Some consider it to be the most important resource of fossil energy of the future, substituting oil and gas in the longer run, provided that the risks inherent in its exploitation are successfully contained. Initial research projects are going on especially in East Asian countries (South Korea and Japan) with limited fossil energy resources (World Ocean Review 2014).

One other possibility to use the seas is the desalination of salt water to provide fresh water for human consumption and irrigation (Ehlers 2016). Desalination is becoming more and more important for dry countries which primarily have to rely on rainfall. More than 663 million people around the world still lack access to clean water (UN 2015). Ehlers (2016) claims that climate change may further exacerbate the situation and lead to increasing demands. One of the problems is the relatively high energy demand needed for the desalination process, but maybe solar and wind power energy will solve some problems. In any case, the use of desalination is steadily growing. According to the International Desalination Association (IDA) (2017), globally, the cumulative installed capacity of the 18,983 desalination plants considered to be online is 88.6 million m3/d. This number includes plants under construction that are expected to be completed by end of 2016. The cumulative global contracted capacity as of June 30, 2016 reached 95.6 million m^3/d, providing water for 300 million people (IDA 2017).

Taking all in all, it becomes evident that the BE is steadily growing. This creates new opportunities. So, it seems justified to label this development with the term "Blue Growth." However, there is no such thing as a free lunch. BE implies massive threats to the marine environment. Whilst it is not the scope of this Chapter, we should be totally aware that oceans and seas are indispensable for human life and survival. That can beis impressively illustrated by building on a quotation from the science fiction author Arthur C. Clarke:

"How inappropriate to call this planet Earth when it is quite clearly Ocean".

1.4 *Methodology*

This Chapter is focused on a literature review methodology (Snyder 2019), which contributes significantly for conceptual, methodological, and thematic development of different domains (Palmatier et al. 2018; Hulland and Houston 2020). According to Kumar et al. (2019), a subject advances when prior studies are synthesized logically based on the findings of prior studies. However, it is paramount to mention that beyond covering past and current research lines, the main goal of an outstanding review article is also to provide detailed and specific directions for future research (Paul and Rialp 2020). Therefore, ideally, this objective should be quite explicit and/or included in the paper's title (Rauch et al. 2009; Rialp et al. 2014). Comprehensively, these perspectives are condensed in Paul and Rialp (2020) who argue that the main purpose of a review article is to critically analyse the extant literature in a given research area, theme or discipline, identifying relevant theories, key constructs, empirical methods, contexts, and remaining research gaps in order to set a future research agenda based on those gaps.

Furthermore, literature review is generally considered a helpful tool particularly in nascent research areas (Shi et al. 2020), as it seems to be case of the BE/BG. This assumption emerged after the first review of the articles that revealed that BE/BG is quite an emerging and cutting-edge concept that has recently gained considerable policy and scholarly attention (Eikeset et al. 2018; McKinley et al. 2019), in line with the expansion of its relevance on the political agenda beyond traditional economic sectors (Pinto et al. 2015; van den Burg et al. 2019). Hence, the rationale behind adopting a literature review lies in the recognition that a classification in terms of domain-based, theory-based, and method-based, as supposed in a systematic literature review article (Paul and Rialp 2020), was not possible due to the highly heterogeneous and fragmented nature of the articles and, thus, the niche features of BG/BG.

Based on this assumption, the purpose of this Chapter is to fill the knowledge gap on how BE/BG can represent an economic development model for institutions and entrepreneurs. It does so by adopting an exploratory approach for the collection and review of a series of scientific contributions to be considered as most significant and most relevant in addressing how the BE/BG discourse is tied up in recent literature on economic development. Specifically, the exploratory approach was designed based on a set of criteria identified in compliance with the objectives of the investigation:

1. frame and evaluate the state of the art with regards to policies and initiatives undertaken at global level;
2. detect critical issues and challenges in the implementation of policies and initiatives;

3. identify policy implications and suggestions.

Accordingly, these objectives are addressed in section 1.5 (1), section 1.6 (2), and section 1.7 (3). Thomson Reuters Web of Science (WoS) and Elsevier's Scopus, were the two main sources for bibliometric data. Scopus is the largest abstract and citation database of peer-reviewed literature, it contains the most important journals regarding our research topic. Also, many authors have published review articles using studies from the indexed journals found in Scopus, which lists a greater number of journals than WoS (Paul & Rialp 2020). Consequently, the target Electronic Database was Scopus. We refined the search to peer-reviewed journal articles published in English avoiding books and grey literature, such as reports and policy documents, and limited it to the 2010-2019 timeframe. In accordance with the research question, BE/BG-related literature was then retrieved by using the following keywords match: ("blue economy" OR "blue growth") AND develop* (which stands for "development").

We did not start by restricting the search to specific academic journals. It was important to include all peer-reviewed journals in order to make sure we had captured every mention of the concept (Compagnucci & Spigarelli 2020). Finally, about 183 relevant papers in total have been found. After the pre-review, 11 papers were selected for a fully read process and further analysis (Table 1). When reviewing this literature, the main perspectives and views on various topics were systematically summarised and compared according to the abovementioned criteria.

However, section 1.1, section 1.2 and section 1.3 of the Chapter are drafted relying also on literature which not necessarily emerged from the search in the database. Such necessity arose based on the fact that the evaluation of the state of the art of what we conceived as a cutting-edge concept – the BE – cannot be separated from its theoretical conceptualization. To this regard, data and information were not always available in the articles analyzed in the literature review and were retrieved elsewhere using forward and backward snowballing (Jalali and Wohlin 2012), not necessarily on the basis of the relevant citations appearing in the 11 articles. This includes other databases, literature suggested by scholars and colleagues, reports from organizations and research centers – both national and international – and the general web.

Table 1: Meta-analysis of the literature on ("blue economy" OR "blue growth") AND develop.*

Authors, Year		Journal	Country of research	Research type and method	Topics
1	Kaczynski 2011	*Foundations of Management*	Mainly Europe	LR; CS;	CI; PSI;
2	van den Burg et al. 2017	*Frontiers in Marine Science*	Europe and overseas	LR; DA; I;	PI; CI; PIS;

3	Howard 2018	*Marine Policy*	/	I;	PI; CI; PIS;
4	Niiranen et al. 2018	*Marine Policy*	Arctic Ocean	LR; CS;	PI; CI; PIS;
5	Hemer et al., 2018	*Renewable Energy*	Australia;	LR; CS;	PI; CI: PIS;
6	Soma et al. 2018	*Marine Policy*	Europe;	TD; CS;	PI; CI: PIS;
7	Eikeset et al. 2018	*Marine Policy*	/	LR;	PI; CI; PIS;
8	Rogerson and Rogerson 2019	*Urbani izziv*	South Africa	DocA; DA;	PI; CI; PIS;
9	Andreadou et al. 2019	*Frontiers in Energy Research*	Greece (Europe)	CS; LR;	PI; CI; PIS;
10	Fotiadou and Papagiannopoulos-Miaoulis 2019	*Frontiers in Energy Research*	Europe	LR;	PI; CI; PIS;
11	Graziano et al. 2019	*Applied Geography*	The Great Lakes Region (US)	LR; CA; CS;	PI; CI; PIS;

Abbreviations: PSI = Policy Suggestions and Implications; PI = Policy Initiatives; CI = Critical Issues; DocA = Documentary Analysis; DA = Data Analysis; LR = Literature Review; S = Survey; CS = Case Study; I = Interview; TD = Theoretical Discussion; CA = Cluster Analysis; / = not specified.

1.5 *Policy Initiatives and Plans in the Blue Economy paradigm*

The concept of BE/BG arose from discussions between countries, international agencies, nonprofit groups, and industry representatives at the United Nations Conference on SD (Rio+20) in Rio de Janeiro, Brazil, in summer 2012. As stated in section 1.3, in Rio there was a big emphasis on the green economy, and leaders recognized that something similar for the ocean was needed. Since then, there is an emerging consensus that attempts to exploit ocean resources must be counterbalanced by the protection of vulnerable ecosystems and against harmful, unprincipled or illegal practices gathered (Rogerson and Rogerson 2019). The result was an international commitment to work towards making any economic activities in the ocean more sustainable, along triple-bottom-line planning improving the financial, social, and environmental health of the community (Howard 2018). This principle is embedded globally in the **United Nations Sustainable Development Goal 14**[3] which commits member states to conserve and sustainably use the oceans, seas and maritime resources for purposes of development (Rogerson and Rogerson 2019).

This goal is manifested in a number of policy and by various initiatives globally undertaken by governments, industry, international non-profits organizations. As emerged from the literature review, an overview on those promoted by both supra-national and national entities is retrieved and offered in the following sections listed by geographical area.

[3] For further details see: https://sdgs.un.org/goals/goal14.

1.5.1 *Europe*

EU's flagship initiative for BE is identified in the **Blue Growth Strategy** (hereinafter referred to as BGS) endorsed by the EU Commission in September 2012. The BGS is presented as a long-term strategy to support smart, sustainable and inclusive growth in the marine and maritime sectors as a whole and recognizes that seas and oceans are drivers for the European economy with great potential for innovation and growth. It is propagated by the European Commission and has found its way into the international arena (see for example OECD 2016). The underlying promise of BG is that it stimulates economic development – increasing jobs and incomes – while securing sustainable management of the marine resources (van den Burg et al. 2017). The BGS recognizes the importance of existing economic sectors such as shipbuilding & repair, transport, fisheries, and offshore oil & gas. At the same time, it points to the potential of five emergent economic activities: aquaculture, coastal, and maritime tourism, marine biotechnology, ocean energy, and sea bed mining (see section 1.3). To ensure tailor-made measures and to foster cooperation between EU countries, 7 sea basin BG strategies have been developed, namely for the Adriatic, and Ionian Sea, the Arctic Ocean, the Talatic Ocean, the Black Sea and the North Sea.[4]

From our point of view, the BGS can be referred to as an extension of the land based policy strategy referred to as Green growth, which the EU has introduced in 2010. To the core of these developments is thus the use of environmentally friendly technologies that can develop products with lower impacts on the environment. In attempts to encourage BG, new legislation were adopted in 2014, by the so-called **Maritime Spatial Planning Directive** (MSPD).[5] This directive is accommodating other EU directives and communications, such as the **Marine Strategy Framework Directive** (MSFD) and the **Integrated Framework Policy** (IMP) (Soma et al. 2018).[6]

Early references to BE-oriented policies and initiatives of the EU can be found in Kaczynski (2011). Economic development of the majority of industrialized countries, including those in the EU, has its reflection in the growing market demand and consumption. Both factors are acting as driving forces of maritime investments overseas, especially in securing an access to the sources of energy and protein of the marine origin. He observes a broad range of ocean uses can be mapped into a small

[4] This content is presented as general reference to which many articles retrieved from the literature review referred to. It is based on official documents from the European Commission that can be accessed at:
https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52012DC0494&from=EN;
https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52014DC0254R(01)&from=EN.

[5] The full text of the MSPD is available at:
https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014L0089&from=EN.

[6] The full texts of the MSFD and IMP are available at:
https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32008L0056&from=EN.
https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2007:0575:FIN:EN:PDF.

set of ocean resources. Against this backdrop, major maritime countries in the world come to recognize the importance of development of marine and ocean industries for their future prosperity as they seek to secure sustainable future by carefully managing and conserving marine resources, which are relatively abundant but finite. By unpacking the new frontiers opened up by modern ocean technology, the author attempts to demonstrate that a sustainable approach to the ocean along with concerted effort and harmonized initiatives by countries are imperatives that could generate significant and long-term benefits for the world community as well as prerequisites for the successful and sustainable development of the ocean resources. In the view of the author, these combine in a convergence of environmental, economic, social, and technical factors that is bringing greater attention to the opportunities available in the world's oceans: in transportation, food production, energy, mineral extraction, biotechnology, human settlement in the coastal zones, tourism and recreation, and scientific research. To this regard, by building on external sources (Jung 2009), he summarizes key directions of the marine policy of several most important maritime nations who have adopted principles of the BE (Table 2), including the US, Japan, Canada, China, Korea.

Table 2: Marine policy directions adopted by major nations.

Country	Major policy directions/measures	Source
USA	Promotion of ocean education; Economic growth and resource conservation along the coast; Coastal and ocean water quality preservation; Enhancement of the use and protection of ocean resources; Advancement of ocean-related science and technology; U.S. participation in international maritime policy.	An Ocean Blueprint for the 21st Century (2004); U.S. Ocean Action Plan Implementation Update (2007)
Japan	Development and utilization of ocean resources; Preservation of ocean environment; Development of exclusive economic zone (EEZ); Securing shipping transportation; Ensuring marine security; Carrying out ocean-related R&D and survey Development of marine and ocean industries; Integrated management of coastal area; Conservation of remote islands; Enhancement of international cooperation; Enhancement of international cooperation; Maritime education.	Japan's Ocean Master Plan (2008)
Canada	International leadership, sovereignty and security; Integrated ocean management for sustainable development; Health of the oceans; Ocean science and technology development.	Ocean's Action Plan (2005); Technology Roadmap Special Report: Thinking beyond our shorelines (2005)
China	Enhancement of people's awareness of the importance of ocean; Securing ocean related rights; Conservation of ocean ecosystems; Development of ocean resources; Integrated governance of ocean.	11th Five-Year Plan (2006-2010) Report on Marine and Ocean Industries

		Development in China (2006)
Korea	Creation of a clean/secure ocean environment; Promotion of the global business and infrastructures for ocean explorations; Protection of the marine environment; Establishment of Northeast Asia shipping/logistics hub; Sustainable development and construction of the fishery industry infrastructures; Securing stable supplies of the fishery products; Development of oceanographic research and extraction of the marine resources; Training of the marine specialists.	Ministry of Maritime Affairs and Fisheries, Master Plan of Marine and Ocean Policy, 2004 Policy direction of Marine and Ocean Technology, Development and Investment, www.mltm.go.kr, 17th April 2009

Source: Kaczynski, 2011.

However, the focus is on the EU. Kaczynski argues that new opportunities created by globalization and increasing role of oceans in economies of many maritime nations are calling for a new effort by the EU to promote research, investment, and other business activities that could generate new opportunities and benefits for the member-states. Current research effort, international debates, renewed attention to the BE and Green Growth create an opportunity for the EU to take a leadership position in the emerging initiatives leading to the sustainable use of ocean resources. As a matter of fact, during last decade, in order to modernize and expand maritime capabilities of its member-states the EU has undertaken many initiatives which are reported in the article. In 2006, the **EU Maritime Policy** was formulated as an ambitious program with multi-disciplinary approach where a lot of attention was given to international relations and as need for an all-embracing maritime policy aimed at developing a thriving maritime economy and the full potential of sea-based activity in an environmentally sustainable manner.[7] Other than the EU Maritime Policy, the author reports that the EU represents and defends overseas maritime interests of such countries as France, Spain, Portugal and Italy. The EU's aid programs for the coastal nations of Africa, Latin America or Pacific and Indian Ocean island states is frequently combined with subsidies for European companies striving to gain an access to the marine resources of developing countries. Foreign aid supporting maritime economies, fisheries, coastal economic activities and oceanographic research are harmonized by EU missions overseas and supported by international cooperation agreements allowing European fleets to exploit marine living resources, employ local crews and support their vessels in the local ports. The author concludes that active support for the BE is consistent with the EU's commitment to green

[7] The full text can be accessed at: https://eur-lex.europa.eu/resource.html?uri=cellar:b2e1b06a-6ca9-4e24-ac15-60e1307f32e2.0003.03/DOC_2&format=PDF.

policies and that successful attainment of international marine policy objectives is dependent on a close cooperation between the EU countries and adherence to the principles of sustainable marine economy. He suggests that by leveraging on their specialists, long-term experience and own maritime potential, the EU coastal states have good chances to join leading maritime nations of the World. Such a capacity would also allow for an open access to various marine opportunities overseas with special focus on the strategically important resources in the oceans and coastal zones of the developing states. Finally, he makes the case for Poland arguing that by joining most advanced maritime nations of the world and the EU, it could create a long-term conditions for increasing involvement in the ocean economic activities. Such activities could generate additional supplies of energy, seafood, ocean minerals and open new opportunities created by the international sea trade.

In a more recent context, Soma et al. (2018) refers to the BGS as a strategy for economic growth in European seas in the context of climate change, increased scarcity of natural resources, the increased vulnerability of the planet, growth in urbanization and the concentration of humans in coastal regions. The BGS is however dominated by promises of technological progress, of technology innovations that contribute to economic progress, whilst securing sustainable management of natural, marine resources. Underestimating the importance of the social dimension of change, the strategy is likely to become a simple technology-oriented approach. The integration in practice of these seemingly opposite ambitions of BG is unclear and it is further complicated by social and institutional barriers to these new developments, such as laws and regulations or earlier (bad) experiences with innovation. A core challenge to innovations is to facilitate change, given existing institutions and sensitivities of the marine ecosystems. Although the BGS clearly has a strong background in economic theory, the authors insist that it also refers to creation of change in the context of existing social relations, encompassing public interventions by multi-actors such as government, NGOs and citizens, among others. In this context the authors point to social innovation as the process of developing effective concepts, strategies, solutions, or other ideas that can help solve challenging societal and/or environmental problems via collaborative action by a group of actors. It can result in changing behavior across institutions, markets or the public sector, and can enhance creativity and responsible action towards a synthesis of social, economic and environmental goals. In brief, the social innovation concept has an acting component that consists of people with particular attitudes and perceptions about what innovation is, aiming for more societal impacts than making profit as such, with whom acting involves learning, networking and collaboration. In this context, the article is aiming at examining the usefulness of the concept social innovation for the use and management of marine resources, and thus as an enabler for the BGS. The examination refers to a theoretical discussion about the two terms ‘blue growth’ and ‘social innovation’ on one hand, and on the other

hand, an empirical case in which mussel producers are interviewed in the Dutch North Sea to address possible barriers to social innovation within the scope of BG. The authors conclude that social innovation may foster and enhance BG by aiming at long term social and ecological qualities, beyond economic development only. As such it is possible to propose social innovation as a potential means to enhance smart, sustainable and inclusive BG but success will be dependent on creating cooperation, inclusiveness and trust between the different actors. At last, a discussion and concluding remarks are provided with further recommendation for follow-up research topics.

van den Burg et al. (2017) refer to the BGS as a strategy that seeks to stimulate smart, sustainable, and inclusive economic and employment growth from the oceans, seas, and coasts.[8] To realize it, the underlying idea in their article is that climate change, biodiversity loss, and deteriorating ecosystems call for a necessary shift to sustainable consumption and production, which is a central tenet of BG. Policy-makers and civil society thereby increasingly turn to the financial sector as a key factor in bringing about this shift. The authors take steps to fill this gap by investigating on how and which investors – a key private actor for realizing BG – can be engaged in the development of the BG sectors. In their view, gaining understanding about motives and concerns when it comes to investing in the BG sectors is necessary to understand how public actors can involve private actors in development of the BG sectors. The authors observe that BG represents a new and ambitious vision and strategy for more and better investments in the ocean economy. However, bringing about BG requires major changes in the way both public and private act regarding these ambitions. It requires new ideas, concepts, policies, technologies, and business models. They inform that although various governance strategies with emphasis on knowledge generation and networking have been deployed, fulfilling the potential of BG requires the upscaling of innovative practices to full commercial scale as well as growth to mature economic sectors.[9] To this end, knowledge and network are not enough sufficient. Financial impulses by investors are also required. Through a four-step methodology that combined both desk- and applied-research approaches,[10] the analysis conducted by the authors reveal three main takeaways. First, there is a large variation of "Blue Growth investors" and that their decision making is dependent on many different variables, including risk management, return on

[8] The **Limassol Declaration on a Maritime Agenda for Growth and Jobs** is also addressed in the article.[8] Endorsed in October 2012 by European Ministers for Maritime Affairs, it can be considered as a side initiative backing the BGS since it aims at creating sustainable economic growth, and employment in the marine and maritime economy to facilitate Europe's economic recovery. See: https://webgate.ec.europa.eu/maritimeforum/en/node/3060. (Last accessed 5/11/2021).
[9] The authors highlight that the European Commission and national governments already invest in development of marine sectors by providing funding to research and development, for example from the European Maritime and Fisheries Fund (EMFF) or the Horizon 2020 SME Instruments.
[10] Please refer to Table 1. A database of investors was developed and analyzed parallel to the study of key literature on investors and investment behavior. Subsequently, an electronic survey was developed and in-depth interviews were held to acquire more detailed insights into the motives of investors.

investment, and the rationale behind their decision/choice. Second, investing is more than simply providing capital, according to many investors. This often means that the investor is actively involved in managing the company and expanding its network to increase impact and revenues. Moreover, investment in BG are seldom the outcome of one-on-one contact by a company and an investor. It rather comes about when different investors – public and/or private investors – are brought together to raise the capital required. Being part of a consortium of investors is a way to spread risks and allows investors to invest in multiple companies. Third, the authors conclude that attracting private investors is therefore of paramount importance to implementation of the new BGS and a match between the public ambitions and private investors, their needs and concerns, is necessary to make this work.[11]

A neuralgic pillar of the BGS as well as one of the most important environmental goals of many countries is the decarbonization of power generation. To this end, renewable energy sources (RES) have been gaining momentum as for pushing the use of renewable energy in the power sector. Andreadou et al. (2019) make the case for blue/marine renewable energy (hereinafter referred to as MRE)[12] installations (tidal current energy, salinity gradient, ocean thermal energy, offshore wind energy, marine biofuels) which offer a variety of new type of RES to be exploited, with a focus on Greek territory. Toward this direction, the authors inform that the EU has initiated the **InnoBlueGrowth**, a community of projects dealing with BG.[13] More specifically it aims to establish growth initiatives and synergies in the sectors of aquaculture, coastal tourism, marine biotechnology, ocean energy, and seabed mining. Among them, **MAESTRALE** project that aims to set the foundations for a strategic deployment of MRE in the Mediterranean area is addressed by Andreadou et al. (2019).[14] Specifically, they aim to seek how MRE plants would be successfully incorporated in the existing Mediterranean cityscapes and/or landscapes, focusing mainly in Greek territory in the context of MAESTRALE. For this purpose, the authors – Greek partners of MAESTRALE project – discuss the current context for implementing MRE potential focusing on research papers that investigate on how to cope with externalities caused by specific MRE technologies that are applicable in Greece. Various proposals for how MRE plants can be embedded successfully in Greek context are offered afterwards. Based on a survey of existing and innovative technologies worldwide, barriers

[11] The authors report that the EU is beginning to gather experience on how to actually make this work, through for instance the Coordination and Support Actions, BG Business summits and other networking events. For further details see: https://europa.eu/newsroom/events/1st-summit-blue-economy-business-and-science-forum_en. (Last accessed (8/11/2021).

[12] In the article of Andreadou et al. (2019) they are referred to as BE. Here we use MRE as to avoid duplication and overlap with Blue Economy.

[13] For further details see: https://blue-growth.interreg-med.eu/no-cache/news-events/news/detail/actualites/the-innoblue-growth-project-offers-a-pop-up-meeting-to-its-large-blue-growth-community-in-rome/.

[14] For further details see: https://maestrale.interreg-med.eu.

and potentials in participating countries, they report that MAESTRALE project's main objective is to transfer available blue energy solutions in the Mediterranean basin by creating a quadruple helix model for their implementation, involving all the actors affected (citizens, scientists, policy makers, local authorities, entrepreneurs etc.) and encourage effective measures and investments for the MRE. Remarkably, they focus on the social dimension of the helix, and more specifically the public acceptance of RES as, according to the authors, it is one of the most crucial factors for the implementation of MRE plants in the Mediterranean. The analysis unveils that Greece is regarded to have a very interesting RES potential due to its climate and overall geomorphology. Although just a few case studies regarding MRE have been developed in the Mediterranean sea until now, the available data for its potential of wave energy, offshore wind, and marine currents prove to be exploitable, ultimately allowing for a new market for installing MRE plants. However, the integration of MRE plants in a certain space is connected to its context, that is different in every case. Their form, size, scale, and arrangement are of critical importance for their social acceptance for which multidisciplinary approaches for their implementation are needed.

In the context of BGS, the potential of MRE is addressed also by Fotiadou and Papagiannopoulos-Miaoulis (2019). They observe that the EU has a strong track record of commitment to RES by pushing member states to adopt national renewable energy action plan in accordance with the targets set in the various RES-focused Directives and Regulations endorsed since 2009. MRE, as an emerging maritime activity which the EU has set as an additional pathway to achieve its energy and climate change goals also through the **Ocean Energy Roadmap**,[15] can contribute in meeting the targets while generating economic growth and jobs. Given the emphasis placed by the EU on RES, MRE technologies have the potential of gradually developing into a thriving new industry and will therefore lay significant spatial claims into the sea in the near future, adding to the pressures of already established maritime activities such as tourism, fisheries and aquaculture, maritime transport. However, the authors claim the highly spatial character of industries like MRE which enables the shift to more spatial approaches of regulation, like the MSPD, that acknowledges the importance of MRE as a driving force for the planning and regulation of marine space and represents a catalyst for the successful implementation of the BGS.[16] For this purpose, the

[15] The Ocean Energy Map is produced by the Ocean Energy Forum. For further details see: https://webgate.ec.europa.eu/maritimeforum/sites/default/files/OceanEnergyForum_Roadmap_Online_Version_08Nov2016.pdf.

[16] The preamble of the Directive 2014/89/EU of the European Parliament and of the Council of 23 July 2014 establishing a framework for Maritime Spatial Planning "The high and rapidly increasing demand for maritime space for different purposes, such as installations for the production of energy from renewable sources, (…) require an integrated planning and management approach." According to Article 5, member states shall aim through their maritime spatial plans "to contribute to the sustainable development of energy sectors at sea, of maritime transport, and of the fisheries and aquaculture sectors," while taking measures to protect and improve the environment and combat climate change. The

article discusses how the introduction of MRE can function as a driving force for the conceptualization of the Mediterranean Sea as space and, subsequently, for its regulation. By building on the case of Sweden, where national MSP together with a **National Maritime Strategy** and the corresponding environmental legislation have succeeded in the correct and successful use of MRE, the article provides evidence that MRE can assist in the conceptualization of the Mediterranean as a space that needs a coherent vision for the future, by functioning as a driving force for the adoption of a spatial regulation approach and, thus, into a driving force for the regulation of marine space for the EU. This in turn will allow Mediterranean countries to reap the multiple benefits from the sustainable development of MRE. Finally, the authors conclude by presenting the opportunities that MRE technologies can bring to Greece and to any Mediterranean country for a prosperous, environmentally friendly and sustainable future.

Some other references to the BGS can be found in Eikeset et al. (2018) who stress that while highlighting the importance of marine areas for innovation and growth in the abovementioned five sectors, the BGI puts increased emphasis on marine spatial planning and coastal protection.

1.5.2 *Africa*

Rogerson & Rogerson (2019) observe that BE debates and planning are of special significance in the global South. It is argued that in Africa as well as the broader arc of countries adjoining the Indian Ocean there is considerable contemporary policy interest in the development of the oceans economy. In this regard, two major initiatives are mentioned: the **2050 Africa's Integrated Maritime Strategy** endorsed in 2015;[17] and the **Jakarta Declaration on the Blue Economy** issued in 2017.[18] The former is a long-term vision for the development of Africa's BE that was endorsed by the Africa Union in 2014 in recognition of the ocean's economic potential, extensive coastline and opportunities surrounding maritime resources. The latter was issued in 2017 and provides a total of 26 recommendations as well as principles for developing and applying blue economy approaches to sustainable development and enhancement of socio-economic benefits, particularly for coastal communities in the Indian Ocean Rim Association (IORA) region.[19] However, it is against a backdrop of the international importance of enhanced planning for coastal and marine tourism that the objective of the authors is the examination of contemporary directions and challenges in South Africa

Directive indicates that all coastal member states had to designate the competent authority or authorities for the implementation of the Directive and transpose the latter into national legislation by 18 September 2016. MSP should be implemented and respective maritime spatial plans established as soon as possible and by 31 March 2021 at the latest.

[17] For further details see: https://au.int/web/sites/default/files/documents/30929-doc-2050_aim_strategy_eng_0.pdf.

[18] For further details see: https://www.iora.int/media/8218/jakarta-declaration-on-blue-economy-final.pdf.

[19] For further details see: https://www.iora.int/en.

concerning planning for the BE as a whole and more specifically for the expanded development of the coastal and marine tourism sector under the umbrella of South Africa's BE strategy titled **Operation Phakisa** (meaning 'hurry up' in Sesotho dialect).[20] Operation Phakisa is unfolded based on documentary analysis of official planning and strategic documents by the authors. The view that this focus on the ocean economy is considered more broadly as part of and closely aligned to South Africa's 2030 National Development Plan[21]– which aims to eliminate poverty and reduce inequality by 2030 – is shared with Rustomjee (2018) and Satgar (2018). At the core of Operation Phakisa is the unlocking of the economic potential of the country's ocean economy through six 'focus areas', including the coastal and marine tourism which is the focus of the analysis conducted by the authors based on national tourism planning documents and spatial distribution data of coastal tourism.[22] The idea is that coastal and marine tourism represents a critical 'new frontier' for BE debates since South Africa's long coast and pristine coastal environments offer a number of untapped opportunities for growing the tourism base around coastal and marine tourism and thereby boosting local economic development opportunities.

Some reference to the African continent is provided also in the article of Howard (2018) who delves into the role that stakeholders play in the development of BG by interviewing a number of important actors.[23] It is reported that some countries are most interested in improving economic opportunities for poor coastal communities, while others are looking to develop global export markets for products they are already producing, in order to fetch higher prices and take advantage of rising consumer awareness of quality and sustainability. In Africa, where BG has perhaps been embraced most enthusiastically, many countries are seeing the framework as a way to bolster artisanal and small-scale fisheries that support millions of jobs but which are often overshadowed by multinational, large-scale fishing operations which can often take advantage of economies of scale. While also addressing Operation Phakisa an interesting initiative is case is made for Uganda. In Uganda, local fishermen are making more money from their catch thanks to an innovative product that also helps

[20] 'Operation Phakisa' is managed under the Department of Planning, Monitoring and Evaluation of the Republic of South Africa. More comprehensive content on different focus areas of the strategy can be accessed via the official website: https://www.operationphakisa.gov.za/pages/home.aspx.

[21] The National Development Plan 2030 is available at: https://www.gov.za/issues/national-development-plan-2030.

[22] The other 'focus' or 'priority growth areas' are as follows: (1) marine transport and manufacturing, (2) offshore oil and gas exploration, (3) aquaculture, (4) marine protection services and governance, (5) small harbors. Two enablers were identified to support them, namely: (1) expansion of skills and capacity building under the responsibility of South Africa's International Maritime Institute and (2) research, technology and innovation with the country's Department of Science and Technology as the key driver. https://www.operationphakisa.gov.za/pages/home.aspx.

[23] Jacqueline Alder, who leads FAO's program in BG, or sustainable development of ocean resources; Maria Damanaki, who pushed for blue growth as the EU's Commissioner of Fisheries and Maritime Affairs until 2015 and now heads up marine policy for The Nature Conservancy; Monty Graham, the director of the School of Ocean Science and Technology at the University of Southern Mississippi; Paul Holthus, the founding president of the World Ocean Council; Tundi Agardy, who founded the nonprofit group Sound Seas; Leonard Nurse of the University of the West Indies.

reduce food waste. Developed in partnership with FAO, the product, **Mukene fish powder**, fights declining wages among fishermen and childhood malnutrition at the same time. In the past, when Uganda's fishermen processed their catch, they often disposed of the heads, bones, and organs. But now they can sell those materials to processors, who dry the parts and then grind them into a powder. The result is high in calcium and other key minerals and vitamins and is easy to stir into stews. The powder is great for kids' brain development is helping reduce stunting that has been a problem there due to lack of good nutrition. At the same time, it is helping fishermen get more value for their fish. This decreases the pressures that cause overfishing, hopefully helping the fish stocks recover over time. The project is an example of a triple bottom line win, improving the financial, social, and environmental health of the community.

1.5.3 *Oceania*

Australia is a marine nation that has made significant efforts – both nationally and internationally – to promote development of a BE. Hemer et al. (2018) discuss how the development of the emerging ocean renewable energy (ORE)[24] industry in Australia offers opportunities for economic development by building Australia's BE, while actively contributing to committed carbon mitigation measures. Such a commitment to and opportunity is demonstrated through the 2013 position paper **'Marine Nation 2025: Marine Science to support Australia's blue economy'**, that recommends the establishment of a decadal to focus investment on the key development and sustainability challenges facing Australia's marine estate.[25] **Australia's National Marine Science Plan 2015-2050** was then launched outlining priority science challenges to meet this need, with a strong focus on Australia's comparative advantage for development of its BE.[26] Furthermore, the National Marine Science Plan proposes a **National Blue Economy Innovation Fund** as one of six priority investment initiatives in the plan with the intention of capitalizing on new opportunities to sustainably develop Australia's BE by promoting and commercializing innovation in ORE, amongst other industries and new ocean technologies. The authors intend to outline priorities for direction of the fund to incentivize transition of existing skills to support the ORE sector, reduce risks and ultimately costs of technology and accelerate the industry to the point that it becomes competitive both nationally and internationally. It is argued that funding and investment play a key role in the development of the ORE sector. The **Australian Renewable Energy Agency (ARENA)** is an

[24] It can be considered as MRE for Europe. However, the abbreviation ORE is used in this case as Australia is surrounded by oceans.
[25] The position paper was prepared by the oceans policy science advisory group of National Marine Science Committee. It can be accessed at: http://www.aims.gov.au/opsag.
[26] The full text is available at: https://www.marinescience.net.au/wp-content/uploads/2018/06/National-Marine-Science-Plan.pdf.

Australian Commonwealth agency whose role is to fill the notable gap in investment to accelerate emerging renewable energy along the innovation chain from early stage research to large scale pre-commercial deployment. Other Government support for ORE has come through the Australian Research Council Linkage program, and potential opportunities exist through the National Science and Innovation agenda. The potential value of the BE in Australia notwithstanding, many interdisciplinary challenges are currently hampering development of the industry in Australia, and globally, including technology, cost reduction, policy and regulations, potential for environmental effects, awareness and investment, amongst others. To address these, the authors build on the Australian ORE symposium (AORES) where the Australian ORE community (ORE technology and project developers, researchers, academics, policy makers and other stakeholders) gather together to identify these challenges and develop possible pathways to grow ocean energy in Australia. Four themes were identified: Technology Development; Education and Awareness; Policy and Regulation; and Finance and Investment. This paper documents the outcomes of the meeting identifying challenges and a way forward against each theme. A key element identified across all themes was the need for stronger coordination across the sector, and the need for a representing body to lead necessary initiatives to support growth and management of the ORE industry in Australia, as one element of a burgeoning BE.

1.5.4 *America*

Evidence of BE model in the US can be found in Graziano et al. (2019). They recognize that even if we currently do not fully understand what the BE means for regional development, it has gained acceptance and importance worldwide as an environmental and economic development strategy. What, in some cases were peripheral or economically declining regions, have become regions of (potential) growth. The authors make the case for the Great Lakes Region (GLR) which is an interesting case study through which to explore and identify issues arising from our lack of a full understanding the regional BE. Since the late 1970s, the US Great Lakes basin has searched for ways to reverse its economic decline and the BE offers new opportunities to sustain the region's economic development, possibly sustaining its transition towards new economic sectors. Although the lakes are inland bodies of freshwater, shared by two countries (the US and Canada), they are subject to "high seas" laws under US policy.[27] As of 2018, the authors reported that several federal and regional initiatives are slowly aligning with BE goals. Whether these initiatives aim to rebuild the ecological

[27] For reference see: US National Oceanic and Atmosphere Administration Office of General Counsel, http://www.gc.noaa.gov/gcil_greatlakes.html. Accessed on: 13 November 2021.

capital of the region, as the **Great Lakes Restoration Initiative** (GLRI),[28] or to bring a new generation of advanced manufacturing for water transportation, as the **Smart Ship Coalition**,[29] or even to highlight the contribution of the region/s ecological capital and call for sustainability, explicitly laid out within the **Blue Accounting Initiative**, [30] they signal an emerging conceptualization of the GLR as a transitioning coastal region. Starting by briefly reviewing the difficulties associated with defining the BE concept and associated industry cluster, the authors argue that a vis-a-vis comparison between definitions of BE used in the EU and equivalent terms used in North America is not straightforward, mainly due to the different scale of the terms used, which range from sectors to industries. With the aim of adopting a comprehensive approach for the scope of the analysis, they build on the definition of BE and maritime clusters used by the EU, thus expanding upon the industries commonly considered in North America. The EU BG industries and the National Oceanic and Atmospheric Administration (NOAA) and National Ocean Economic Program (NOEP) Ocean Economy industries were included as maritime clusters (Figure 2).

Figure 2: Industries included in the study: "Our Approach".

Source: Graziano et al. 2019.[31]

By adopting a cluster approach that emphasizes *trans*-industry synergies and that is based on the use of standard metrics,[32] the aim of the authors is to identify how regional characteristics and

[28] For further details see: https://www.glri.us.
[29] For further details see: https://smartshipscoalition.org/.
[30] For further details see: https://www.blueaccounting.org/.
[31] Red color shows clusters not included by Ketels and Protsiv (2016), but included in the study.
[32] E.g.: employment, location quotient (LQ), Gross Regional Product (GRP; the value added per cluster), and Labor Productivity as indicators of the importance of the BE in the GLR, and as a proxy to understand whether the GLR possesses the know-how to capitalize upon this new set of opportunities.

intersectoral conflicts can pose issues to both policymakers and researchers. A methodological approach allows for comparing the findings with previous works conducted in other regions. From this comparison, and by comparing inter-state differences, the authors find that the BE in the GLR comprises highly-productive clusters, although employment specialization remains low. The results have revealed a number of key findings. Firstly, regarding BE policy in the GLR region, specific lessons relate to focusing on the heterogeneity of the region, the importance of regional stakeholders beyond jurisdictional boundaries, and strategies for achieving a GLR BE vision. Secondly, and perhaps more pertinently, the results have revealed general lessons for understanding the BE in relation to regional development. To the Great Lakes basin, the work of Graziano et al. (2019) represents a benchmark analysis that provides a snapshot of the current strengths of GLR for building a potentially thriving future within the concept of the BE in a region only recently emerging from a long period of economic and demographic decline. Policy implications for the GLR and issues that emerge when framing the BE within regional development are provided afterwards.

1.5.5 *International Organization and Cross-country's Initiatives*

Partially addressed by Eikeset et al. (2018) and Soma et al. (2018), the UN FAO's **Blue Growth Initiative (BGI)** stands as a milestone on the international arena. Due to a recognition of the importance and need for the aquaculture and fisheries sector to sustainably grow in order to meet rising seafood demand and contribute to poverty alleviation, and the fact that zero growth of fish production is neither realistic nor desirable, it was launched in 2013 in support of food security, poverty alleviation and sustainable management of living aquatic resources. As a consequence, and within the context of its mandate, FAO defines BG as economic growth and social development emanating from living resources of the oceans and inland waters and from related activities in the coastal zones, which minimize environmental degradation, biodiversity loss and unsustainable use of living aquatic resources. The BGI builds on the existing strong international legislative and policy framework centred around the FAO Code of Conduct for Responsible Fisheries and its related international agreements, guidelines and plans of action. The challenge is to provide incentives and adequate resources to adapt and implement this framework at the local, national and regional levels to secure political commitment and governance reform, including by building effective institutions that lead to the adoption of ecosystem approaches to fisheries and aquaculture with fair and responsible tenure systems.

The FAO BGI aims at enabling the catalysis of policies, investment and innovation which would underpin sustained growth and give rise to new economic opportunities in ecosystem goods and services. It would integrate key aspects of economic performance, such as poverty reduction, job

creation, social inclusion and community resilience, with those of environmental performance, such as mitigation of climate change, ecosystems and biodiversity restoration. It would mobilize financial and technical support and build local capacity for the design and implementation of BG Strategies and create action-oriented policy options and institutions tailored to the respective economic circumstances and constraints of countries. The BGI also promotes partnerships among industry, governments and communities at all levels. The recognition of the fundamental role the private sector and public-private partnerships will play in changing current behaviors and technologies, and accepting that short-term economic impact will be superseded by long-term economic gain, is essential. The BGI is structured around four streams of work: capture fisheries, both from marine and inland waters; responsible intensification of aquaculture; secured food systems and improved livelihoods; economic growth from ecosystem services. FAO uses its expertise in headquarters and the field, its networks and strategic partners, to promote projects around these four streams of work that support actions with BG impact at the global, regional and national levels.[33]

Niiranen et al. (2018) make the case for BG in the Arctic Ocean which can be considered as a cross-country case of implementation of BE/BG-oriented initiatives. The BG concept is referred to as a response to the natural resource use challenge in oceans by combining the aspects of economic growth and environmental sustainability. In comparing the EU's BGS, conceived as the framework for sustainable economic growth from its oceans, seas and coasts, with the United Nations FAO's (BGI), formulated as an opportunity to promote sustainable socio-economic management of capture fisheries and aquaculture, they define BG as using the oceans to create maximal income to society in a way that is ecologically, socially and economically sustainable, e.g., preserving the functioning of all ecosystem services accrued from the oceans. This implies making better use of the oceans via improved natural resource management across different sectors, as well as using the inputs coming from the oceans in a better way on shore.

The authors argue that due to the frontier nature of the Arctic, the Arctic model for BG is likely to differ from that in the more exploited systems, including many European seas. Since, globally, fish and seafood are amongst the most valuable renewable natural resources and most traded food commodities, and one of the BG sectors where some well-established management structures are readily in place, the case for Arctic capture fisheries and their future development potential is made in the article. The BG of Arctic fisheries is a particularly interesting case since they are complex

[33] This content is presented as general reference to which many articles retrieved from the literature review referred to. It is based on official documents from FAO that can be accessed at:
https://www.fao.org/3/CA0268EN/ca0268en.pdf
https://www.fao.org/3/v9878e/V9878E.pdf.

social-ecological systems that are exposed to several cross-scale interactions across different temporal and spatial scales that are affecting important ecological and socioeconomic processes, as well as their interaction. Unlike most other regions, due to global warming the global models project future increase in fisheries catch potential due to increasing biological production and temperature-driven Northwards movement of fish. These provide future projections of easier access and increased biological productivity. At the same time, this raises several concerns, unregulated fishing concern amongst others. To this regard, the focus of the research is to fill the gap by illustrating how such cross-scale interactions at, and across, different dimensions (e.g., ecological, socioeconomic and governance) can affect the development of Arctic fisheries. Using examples from the different seas of the Arctic Ocean, particularly the Barents Sea and the Central Arctic Ocean (CAO), the authors study how the Arctic fisheries socio-ecological systems (SES) are connected to their surroundings, and what can cross-scale interactions mean for the future expectations of Arctic BG and potentially create uncertainties for future BG projections. The examples show that, both systems are affected by a number of processes, beyond the environmental change, spanning a wide range of dimensions, as well as spatial and temporal scales. To address the complexity of the Arctic marine systems calls for an increase in holistic scientific understanding together with adaptive management practices. To this regard, the five nations bordering the Arctic Ocean (Canada, Denmark, Norway, Russia and the US; referred to as the Arctic5 nations) recently signed the **Declaration concerning the prevention of unregulated high seas fishing in the central Arctic Ocean** (referred to as the Arctic5-Declaration) that can be seen as the first step towards more robust fisheries governance in the CAO.[34] This declaration is largely seen as a platform to facilitate international scientific collaboration of the region and follows the precautionary principle by stating that no commercial fishing should take place in the CAO before sufficient scientific knowledge and regional fisheries management structures are in place. In conclusion, the authors claim that recognizing how cross-scale dynamics can cause uncertainties to the current fisheries projections and implementing well-functioning adaptive management structures across different Arctic sub-systems can play a key role in whether the BG potential in Arctic fisheries is realized or lost.

The geographical lens adopted in this Section 1.5 for mapping the state of the art reveals that after its conceptualization, a roll out of policy and initiatives in BE/BG is in progress on a global scale. It confirms the considerable policy and scientific attention that the concept has gained, as mentioned in the methodology Section 1.4 (Eikeset et al. 2018; McKinley et al. 2019). At the same

[34] The Arctic5-Declaration bans unregulated fishing within the 2.8 million km2 area of the CAO and is a precautionary measure as no large scale commercial fishing is expected in this region in the nearest future. A conceptual framework is provided at: http://dx.doi.org/10.1016/j.marpol.2016.01.013.

time, a series of criticalities surrounding the concept and challenges impacting on a full and effective implementation of BE/BG can be observed. Section 1.6 draws upon the same literature to group and reflect on those emerged as prevailing.

1.6 *Critical issues on the implementation of Blue Economy and Blue Growth*

When it comes to implementing BE/BG, the criticalities exhibited in the literature are of different and various character. This, in our view, is in line with the observed heterogeneous and fragmented nature of the approaches to the concept, which eventually guided the methodology adopted for the selection and review of the articles. However, some conducting lines on common issues to be tackled and assessed can be drawn depending on the different level of analysis.

One of the most apparent obstacles is the interdisciplinarity and the lack of a common agreed goal of BG (Eikeset et al. 2018). The potential for miscommunication is great and it is also influenced by the incoherence and mismatches observed at the EU policy level when comparing the BGS with different EU directives and regulations that attach different incentives to sustainability and ecosystem-based management (Soma et al. 2018). Such a misalignment ultimately results in the identification of knowledge gap and raises conflict of interests among relevant stakeholders (scientists, politicians, industry) (Eikeset et al. 2018). Issues of multi-level governance of different scales (social, ecological, economic) that persists across multiple jurisdictions (Graziano et al. 2019), failing to incorporate local knowledge with scientific information in the decision making of marine governance (Soma et al. 2018), poor understanding of possible mechanisms for the implementation of integrated policies (Eikeset et al. 2018), and issues of confidentiality and reluctance of investors towards sharing ideas and information with science (van den Burg et al. 2017), add to the incompatibility of knowledge system and result in frail management plans (Soma et al. 2018). The lack of representation of industry and associated stakeholders by any existing organization, structure or institute recorded in Hemer et al. (2018), further exacerbates these dynamics. Hence, it is safe to assume that resolving conflicts and converging towards a common understanding and governance approach between relevant stakeholders is difficult and requires a holistic approach to a governance that cut across sectors (Eikeset et al. 2018).

Another level of analysis regards the dichotomy between issues of sustainability and economic growth. As a matter of fact, the adoption of an ecosystems-based approach – focused on the conservation of marine resources – is challenged by the pragmatism of prioritizing old-fashioned economic models – focused on investment attraction and economic growth – and this is recorded in several studies (Kaczynski 2011; Eikeset et al. 2018; Howard 2018; Soma et al. 2018; Fotiadou and Papagiannopoulos-Miaoulis 2019; Rogerson and Rogerson 2019). Examples of such a divergence are

reflected and manifested at different levels. At the policy level, BE/BG is seen both as a way to save countries from poverty and declining GDPs but too often conservation voices are drowned out by more powerful commercial ones. This eventually results in natural disasters that can dramatically merge with public health issues due to ignoring the deterioration of the environment for exploitation purposes (Howard 2018). At the firm level, implementing BE/BG requires a 'systems' or 'better than neutral' approach – in contrast with the minimization and mitigation approach of conventional green strategies – and this sets a new, high level standard of performance (Kaczynski 2011).

Financial issues emerge as a third criticality, especially when it comes to investing in BG. Risk and barriers to investment are rooted in several factors. First, poor-designed government support and subsidy scheme make it difficult to access finance and brings about operational and financial concerns (van den Burg et al 2017). Second, confidence in technology is challenged by a mix of regulatory problems and time-consuming procedural aspects (van den Burg et al. 2017; Andreadou et al. 2019), coupled with policy uncertainty that hampers the development and commercialization of BG-related products and technology (Hemer et al. 2018), and challenges associated with educating a work force who have the capacity to meet the challenges of emerging sectors (Hemer et al. 2018). Third, technicalities such as connectivity problems and the dependence of certain BG technologies on weather conditions (Andreadou et al. 2019), along with priority concern when it comes to the optimization of energy while maintaining low costs and low environmental impact (Hemer et al. 2018), as well as issues of public acceptance with regards to social and visual externalities brought by the installation of BG technologies (Andreadou et al. 2019; Howard 2018), also interfere with investment.

Finally, managing cross-scale interactions of SES (Niiranen et al. 2018), which is also dependent on the heterogeneity of marine/coastal regions (Graziano et al. 2019), result in shortcomings in MSP and in the lack of specific and pertinent legislation as in the case of MRE installations (Fotiadou and Papagiannopoulos-Miaoulis 2019). These, raise policy and regulation challenges with regards to the management of the multiple uses of marine environment (Hemer et al. 2018; Fotiadou and Papagiannopoulos-Miaoulis 2019), which also impact on investment behaviors. Reportedly, all the above mentioned factors mine investment attraction and reduce the willingness to invest (van den Burg et al. 2017; Hemer et al. 2018; Andreadou et al. 2019) that eventually result in challenges towards the full end effective implementation of BE/BG.

In this Section 1.6, the analysis of the literature has revealed the criticalities emerged in the roll out and implementation of BE/BG-oriented policies and initiatives framed in Section 1.5. Such criticalities stem from: 1) the interdisciplinarity and the lack of a common agreed goal of BE/BG; 2) the dichotomy between issues of sustainability and economic growth; 3) financial and investment

issues; 4) shortcomings in MSP and pertinent legislation that impact on management of the multiple uses of marine environment. Accordingly, Section 1.7 discusses the policy implications in addressing the above mentioned challenges while also providing policy measures and suggestions that can act as enablers for the effective implementation of BE/BG to boost economic development opportunities.

1.7 *Policy implications and suggestions for implementing Blue Economy and Blue Growth*

As a result of the analysis and consultation undertaken in the literature review, a number of policy implications and suggestions arose which reflect on and also shape the way the criticalities examined in Section 1.6 can be addressed. These are outlined below.

1) *Interdisciplinarity and the lack of a common agreed goal of BE/BG*

Interdisciplinarity should be seen as a potential, not as a threat. Interdisciplinary and multidisciplinary research is of prominent importance when discussing the challenges and opportunities for BE/BG, especially as one major challenge is to obtain efficient communication between the involved disciplines (Eikeset et al. 2018; Graziano et al. 2019). Scientists, policy makers, business people, the larger society need to become more precise and transparent in their language. In addition to the within-science dialogues, there is the need to have a clear and comprehensible dialogue with stakeholders (Eikeset et al. 2018; Howard 2018).[35] In terms of BE/BG, the wide demographic can be considered a stakeholder since the entire population, the planet, will be affected by BE/BG (or the lack thereof). Additional research that would benefit from close collaboration and co-development with stakeholders is central to BE/BG and necessary to ensure that research informs and supports viable, integrated, and comprehensive solutions and their implementation so as to socially optimal use ocean-based natural resources (Eikeset et al. 2018). As such, communication is key here and discussion of the meanings and implications of this increasingly globally important term is badly needed. Increasing communication between those working on BE/BG is of utmost importance and should be encouraged at all levels, especially considering the different background of those who have a role to play in SD.

To this end, on the policy level, social innovation, which is associated with a process of alignment, where different stakeholders exchange values and ideas to come to a shared understanding of problems and the best solutions (Soma et al. 2018), should be fostered. Social innovation is based on the belief that enablers, people with initiatives that go beyond making profit to also aim for social and/or ecological well-being, can perform and influence commonly defined societal goals based on

[35] Stakeholders are essentially people with interests or concerns in a process and its outcome.

shared norms, values and understanding that motivate cooperation (Soma et al. 2018). For instance, a network based social innovation approach is inclusive to the network participants by definition, and gives possibilities for exchange of knowledge and ideas for innovation (Soma et al. 2018). Dissemination of knowledge on the need and benefit of adopting interdisciplinary research, dialogues and approaches among this kind of network, would surely help towards understanding each other' terminology and concepts. More awareness can lead to enhanced communication among colleagues and across disciplines and to the convergence towards an operational definition of BE/BG which is necessary to address the incoherence and mismatches observed at the EU policy level. Such a convergence will finally contribute to a more balanced strategy to create comprehensive science-based policy that delivers net social and economic benefits, benefits the aquatic environments, particularly marine systems, and combats the effects of climate change and global process of anthropization.

2) *The dichotomy between issues of sustainability and economic growth*

The root of this dichotomy can be traced back to when much of the ocean was out of sight and out of mind, and that led to a lot of degradation. Unbalanced growth could lead to catastrophic consequences if multinational companies move in to island nations with big developments that siphon profits overseas and leave the local environment impoverished. The promise of a few jobs is not enough to justify a project that might have significant social or ecological downsides. Against this backdrop, the vision of BE/BG is not just to preserve ocean and coastal ecosystems, but also to ensure that they are managed sustainably to support communities and economies into the future. BE/BG is not about business as usual, which had as its primary focus increasing production. It is about looking at other social, environmental, and economic aspects in a more integrated way. BE/BG's holistic approach makes sense as the concept moves forward, since the value of its resource will become more central to the economic discourse. However, a lasting ocean-based economy is possible only if inherent sustainability is guaranteed. Therefore, an emphasis on long-term sustainability as a core value built within the concept of BE by many scholars and policy initiatives, has to be taken in to account (Howard 2018; Graziano et al. 2019). A clear example is identified in the aquaculture sector – the fastest growing segment of the seafood industry – that is going to have to play an increasingly important role. But aquaculture must also be practiced in a way that minimizes harm to the ocean and inland environments, through smarter sourcing of feedstocks and control of waste and escaped animals (Howard 2018).

As for the case of interdisciplinarity, the opportunity provided by more collaborative processes would also help address the dichotomy between issues of sustainability and economic

growth (Howard 2018). In a business as usual scenario, marine industries are often seen in adversarial roles against regulators or environmental organizations, and portrayed only as the cause of ocean problems. But industry can often be the solution. To make this viable, companies should be encouraged to get involved in BE/BG early, to pool resources and to work constructively with scientists, governments, and advocacy groups to solve problems and minimize or mitigate harm to the environment and social welfare (Howard 2018). An early involvement of companies will allow for less expensive operations, with a little investment in time and new technologies upfront, versus facing fines and bad publicity or even losing access later. Pooling of resources and sharing of best practices are ways industry can contribute with to accelerate BE/BG. Linked to industry's behavior, it is also the important role that consumers play. If consumers demand change and become more responsible, industry will respond.

On the policy level, BE/BG done right can be transformational for a country and has the potential to create millions of new jobs. But policy must be based on investing in marine ecosystems, not just exploiting them, and it must be conducted with a true underpinning of sustainability, and include a diverse range of stakeholders, from local people to industry, advocacy groups, and governments (Eikeset et al. 2018; Howard 2018), with a solid commitment of political and financial investment to make it work. Gaining perspectives from stakeholders is essential to the unfolding of sustainable economic development policy in BE/BG that policy-makers, scientists and business people alike can relate to and agree upon. Moreover, as in the case of coastal and marine tourism, it is critical that researchers undertake careful monitoring to determine whether future initiatives for unlocking the potential of BE/BG conflict with sustainability issues (Rogerson and Rogerson 2019). Cooperation and mutual understanding are not easily achieved, but they are essential to help focus attention and highlight the immediacy of problems and, ultimately, to success in achieving the goal of SD. As far as corporate policy is concerned, being it a cross-disciplinary field, BE/BG is developing models and measurements for valuing the services that ecosystems provide, and provides a framework for defining what is and is not a profitable business. To this regard, an interesting approach if offered by ecological economics that builds the cost of environmental degradation into its markets (Kaczynski 2011). As more of these external costs are internalized as firm costs, BE/BG companies will be more economically viable. Such principle can be applied at the national level where the adoption of sustainable marine economy principles by many European countries together with investments in infrastructures (Kaczynski 2011; Rogerson and Rogerson 2019), preparation of specialists and commitment of each society to tie up its future with the healthy ocean environment might have powerful impact on their overall economy and affect satisfaction of their needs and oceanic aspirations.

3) *Financial and investment issues*

When it comes to financial issues, the capacity of both attracting and stimulating investments play a fundamental role towards the development and effective implementation of BE/BG. Policy support should take a two-sided approach with a focus on technology-push policies and stimulating the market by market-pull policies (van den Burg et al. 2017). Improved tariff and incentives structures such as tax breaks, loans, bonds and guarantees to help to increase access to finance through stable, long-term support schemes would serve this purpose. Government support must go further than financial support for research and development or technological demonstration projects. It is in mitigation of the financial risk where governments have an important role to play. With regards to operational risks, whereas technology developers are in the lead to reduce technological risks, the involvement of investors in company management can help to mitigate market risk as they bring in experience and knowledge and can help to open up new networks for the company they invested in while also creating new employment opportunity (van den Burg et al. 2017; Hemer et al. 2018). Tied in a reciprocal relationship, governments need to attract private investor – their capital, knowledge and networks – to further growth the BE/BG sectors while investors need stable, smooth predictable and effective government support schemes to mitigate their financial risks. Their networks can bring new insights and knowledge about the market and the technology.

The latter, in particular the lack of confidence in technology, represents a critical aspect in relation to the willingness to invest. The literature offers various options as for coping with such a criticality. It is reported that technology would benefit from the development of a dynamic investment tool, which directs developers to potential financing options (e.g., R&D funding and private investor schemes), guidelines for policy and legislation requirements, and research contacts and advances, and assessment of project readiness (Hemer et al. 2018). Launching of program that will connect the entrepreneur and investment communities with ocean-based businesses, with the goal of injecting fresh capital and expertise into the creation of new, greener technologies, should be pushed (Howard 2018). Development of policy which recognizes the added value of predictability and consistency, would support development of a robust and reliable technology. Increased awareness, and policy to support these benefits (e.g., tiered incentives) are required to turn this investment challenge around. With specific regard to MRE, further support to overcome and share technology-related difficulties can be provided by an institutional focus on the establishment of test facilities, which have manifold benefits (Hemer et al. 2018). Apart from serving as testing ground for the development and commercialization of technology as well as solving connectivity and energy storage technicalities (Andreadou et al. 2019), they also provide an opportunity to educate and build awareness of MRE

through all levels of society, forming a nexus for communication and sharing of knowledge (Andreadou et al. 2019). Such a facility may also provide opportunity for public demonstrations and communication and education programs (Hemer et al. 2018). Moreover, transferring technical skills and resources developed in well-stablished sectors towards less mature ones, as MRE and related supply chain, will no doubt accelerate the delivery of renewable energy from our oceans and allows MRE to provide opportunity for economic development (Hemer et al. 2018). Supporting secondment of personnel from well-stablished industry would introduce experience into the emerging sector, and offer a means to redirect government investment in to support the emergence of MRE. Finally, capturing information from failed projects, with cause of failure understood, would be important to ensure that knowledge is maximized by nurturing it among a strong collaborative network crossing industry, government and academia (Hemer et al. 2018). There is high value in these priorities being defined from a sectoral perspective. This would also help obtaining significant cost reductions for MRE to be achieved by collaborating more closely with other sectors, ultimately positively impacting and raising the willingness to invest (Hemer et al. 2018; Andreadou et al. 2019). Finally, an efficient training system must be integrated with considered policies to deliver targeted education such as facilitation of PhD and industry secondments (domestically and internationally) to ensure enough qualified workers can fill current and future critical positions in a growing, emerging, and highly technological sector (Hemer et al. 2018). In the long term, this will not only increase confidence but also guarantee the sustainability and innovation of technology.

With regards to issues of public acceptance that influence investors' behavior, it is a phenomenon that, historically, has often been encountered with the adoption of new technologies but also with new architectural forms in public spaces (Andreadou et al. 2019). For the proper implementation of BE/BG-related technology in a local community, some guidelines which can mitigate opposition and build trust and confidence among investors are offered. Using RES and especially wind and hydropower, are well common practices for many centuries. Windmills and watermills were used for centuries and are part of many European Countries vernacular architecture. In most cases they are not only received positively, but they become tourist attractions themselves. This has been possible due to the fact that the principles that have to be considered is their smaller scale ad integration with the existing landscape (e.g., windmills) (Andreadou et al. 2019; Fotiadou and Papagiannopoulos-Miaoulis 2019). Building on these common practices, new MRE installations should be integrated to the local landscapes and townscapes, and should be downsized, by breaking the scale into more, small scale farms which are more preferable due to their lower impact on the landscape.

On the policy level, it is suggested that architects and design professionals should be included in the teams responsible to design plants and, in cooperation with engineers dealing with matters like power production, noise, and various estimations, will deal with the aesthetic part of the MRE plants, and their integration to the local natural and cultural environment (Andreadou et al. 2019; Fotiadou and Papagiannopoulos-Miaoulis 2019). [36] For example, complementing a promontory and/or surrounding a gulf in a linear way, might be some design solutions to consider. Moreover, involvement of local communities in the creation of the MRE plant, in a participatory design manner, is also considered to have a positive in the mitigation of issues of public acceptance (Andreadou et al. 2019). In urban areas there could be a potential for algae biomass exploitation. This is a type of MRE that does not have visual impact, so wherever applicable, it could be used as a complimentary type of MRE. Tidal/marine current technologies can be implemented as alternative forms of RES. It could be the most socially accepted type of technology since it is more likely to cause less conflicts due to the lack of visual impact (Andreadou et al. 2019). Analogously to the way test facilities can address the lack of confidence in technology, small pilot plants could test the viability of such projects as well as raise social awareness about these types of RES (Hemer et al. 2018; Andreadou et al. 2019). In other words, BE/BG plants should not be scattered in any place, ignoring the surrounding environment. If the design does not respect the surrounding historical landscape/cityscape local opposition to BE plants will surely arise (Andreadou et al. 2019).

4) *Shortcomings in MSP and pertinent legislation that impact on the management of the multiple uses of marine environment*

BE/BG encourages smart, sustainable and integrative solutions. In particular, the EU instructs integration of different uses along the coast. Aiming at the integration of the maritime dimension of some coastal uses or activities and their impacts, and allowing for an integrated and strategic vision, are core principles embedded in the MSPD (Soma et al. 2018). As we mentioned in Section 1.5, MSP is an important component of the legislative framework supporting the development of BE/BG. The benefits of its effective implementation are manifold and can be discussed at different levels.

First, it can address the complementary or competing uses of the marine domain that generates conflict of interests (Hemer et al. 2018). Any new use/activity that has to be implemented needs to be taken under careful consideration considering that they might affect the rest of maritime activities, and should respect the coexistent uses to the possible extent, in order not to affect local economies

[36] Design professionals should also be involved in wind turbine design, so as to find ways to decrease its scale while retaining the capacity favored (e.g., creating hybrid systems in order to reduce visual impact, find alternative ways to design wind turbines in order to decrease their visual impact etc.).

(Andreadou et al. 2019; Fotiadou and Papagiannopoulos-Miaoulis 2019). Implementation in historical and cultural landscapes, spaces that are of great importance for local communities, also should be considered. Otherwise, strong public opposition might arise (Andreadou et al. 2019).

However, MSP allows to make sure that most biologically important and sensitive areas are protected, while other uses flourish elsewhere and can work as a helping hand to the development and growth of other sectors (Howard 2018; Fotiadou and Papagiannopoulos-Miaoulis 2019). Key to this approach is intensive data collection and analysis (Howard 2018). In this regard, a comprehensive analysis of tradeoffs between different ocean uses as well as integrated management of multiple relevant economic sectors requires coordination among and cooperation from very different scientific disciplines and stakeholders (Eikeset et al. 2018). Moreover, it is argued that a necessary step for managing the tradeoffs between different BE/BG sectors, is the inclusions and involvement of local communities by adopting of participatory approaches at governance and policy levels (Niiranen et al. 2018). These can contribute to reduce local and regional resistance to certain uses of the coastal and water space, while increasing the chances of ecologically and economically sustainable outcomes (Graziano et al. 2019). To help the operationalization of the BE/BG, review of current emerging methods to characterize and quantify inter-sector interactions as well as decision-support tools to help managers balance and optimize around interactions (Eikeset et al. 2018). A detailed MSP and a further linkage of legislation with up-to-date databases of protected areas, sea traffic, fisheries, and other maritime activities, underwater archeological sites, submarine cables and pipelines, military protected areas, could clearly define the areas where BE/BG sectors and technology can be implemented (Andreadou et al. 2019; Fotiadou and Papagiannopoulos-Miaoulis 2019). Such an analysis should also investigate the economic contributions of the BE/BG sectors in national economies, understand future development plans, and identify how BE/BG might contribute to national development plans (Howard 2018). It can also help to address issues of heterogeneity that is important to understand for the potential and competitiveness of countries if BE/BG strategies are implemented (Graziano et al. 2019). This way leaders have a clear picture that informs decision making. It is a big picture, because oceans provide US$ 24 to 60 trillion in valuable services a year (Howard 2018).

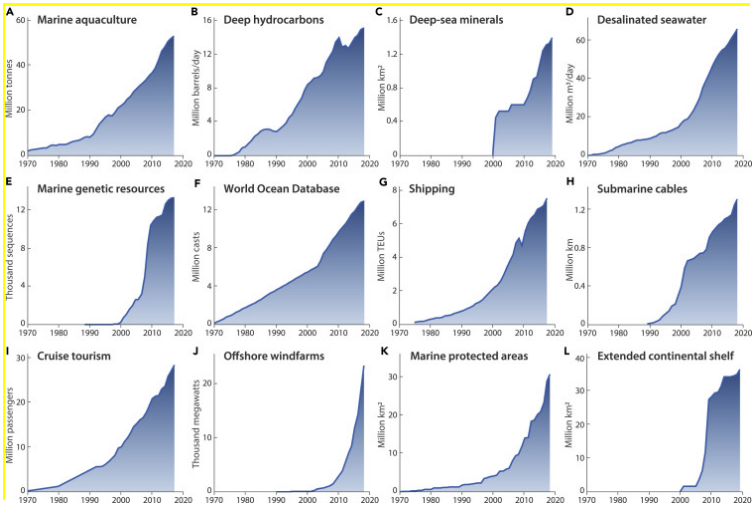
Effectively applying MSP allows for creating new areas of expertise and research for small and medium-sized enterprises (SMEs), while leading countries to further economic prosperity, energy self-sufficiency and CO_2 emissions reduction. To this adds, the new inventions and final products related to MRE products that are created by Start-Ups, SMEs etc. and are introduced into the market providing the opportunity for export of intellectual property (Hemer et al. 2018; Fotiadou and Papagiannopoulos-Miaoulis 2019). Under well-balanced decisions and when the scenario can be clearly and diligently organized at the legal, environmental, economic and social level, only BE/BG

concept and technology can grow and secure prosperity, environmentally and friendly sustainable growth (Fotiadou and Papagiannopoulos-Miaoulis 2019). It is also reported that the development of appropriate planning frameworks will ultimately help industry by smoothing the development process, giving greater certainty and timelines for approvals, providing social license to operate, and avoiding costs associated with potential approval-related project delays (Hemer et al. 2018).This will require cooperation across sectors, across governance arrangements, across stakeholders, as well as integration of policy goals, activities and stakeholder roles (Soma et al. 2018; Niiranen et al. 2018). Cooperation to detect BE/BG potentials as regards their physical, legal, technological, economic, and social contexts, ultimately create a more safe environment for future investments (Andreadou et al. 2019). To this end, being BE/BG a cross-disciplinary field, the establishment of a cross-sectoral body is suggested in order to serve as a management centre of many and broad responsibilities. It will coordinate a BE/BG industry development roadmap, through effective communication of challenges and advantages with government, policy makers, and among industry, researchers, community and relevant stakeholders. It will also allow to develop a knowledge database of BE/BG industry learnings, an investment tool to assess and guide project readiness (Hemer et al. 2018).

1.8 *Conclusions*

The BE/BG concept was first articulated in 2012 by the Small Island Developing States (SIDS) at the 2012 Rio+20 Summit on SD. This novel idea was coupled with a concurrent approach that sought to transform traditional ocean economies into an ecosystem harnessing oceanic resources for better conservation of the marine environment. Ever since, the BE/BG concept and its implementation has remained an evolving one. The broad consensus is that diminishing land resources have induced greater pressure on ocean assets to feed faster growth. At the same time, realization of the dangers of unsustainable approaches is equally compelling. The oceans remain the foremost climate stabilizers as they directly absorb heat and recycle an overwhelming share of greenhouse gases. Rising sea levels are causing submergence of valuable land, and extreme weather conditions and rising temperatures will eventually disrupt the water cycle, and hurt agriculture, fisheries and the rich marine biodiversity. The need to find mitigating solutions ensuring that future economic growth and development be more sustainable remains more pronounced than ever. As per few estimates, in many sectors, the ocean-based productivity will exceed the corresponding land-based production both in terms of value and employment generation by 2030. However, these benefits would likely accrue only in case of the oceans remaining healthy.

Figure 3: Trend of activities related to the exploitation of ocean resources (1970-2020).



Source: Jouffray et al. 2020.

A recent study (Jouffray et al. 2020), documents the unprecedented surge in the development of economic activities in the ocean, which clearly highlights an exponential trajectory of the new and traditional commercial uses that concern it (Figure 3). While some ultra-rich seem to be preparing to flee to other planets, for those remaining on Earth, the ocean, which covers two-thirds of the earth's surface and still has vast untapped resources, represents one of the most promising frontiers for meeting the growing demand for food, raw materials and even space.

The purpose of this Chapter is to fill the knowledge gap on how BE/BG can constitute an economic development model for institutions and entrepreneurs. It does so by building on a collection of key academic literature and scientific contributions to frame and evaluate the state of the art with regards to policies and initiatives undertaken at global level. While not a comprehensive list, the literature provides a starting point for future dialogue on a co-ordinated scientific platform supporting the BE/BG agenda working towards a successful SD. The results presented reveal some critical issues in the effective implementation of BE/BG practices, namely: 1) the interdisciplinarity and the lack of a common agreed goal of BE/BG; 2) the dichotomy between issues of sustainability and economic growth; 3) financial and investment issues; 4) shortcomings in MSP and pertinent legislation that impact on management of the multiple uses of marine environment. Accordingly, potential policy implications and suggestions were critically analyzed by means of providing specific reference and assessment to each of them. It is possible to leverage on nature-based solutions as potential means to enhance smart, sustainable and inclusive growth. Yet, successful BE/BG is dependent on the ability to communicate across vastly different perspectives. To this regard, it is noteworthy that the role and significance of a strong network and coordination of relevant stakeholders – government, policy makers, industry, and researchers – together with the inclusions and involvement of local

communities by adopting participatory approaches at governance and policy levels, emerged as an umbrella under which the specifity and uniqueness observed in technicalities of each criticality can be addressed. These are the people to focus on when scientific findings that illuminate paths or policy changes that could lead to more sustainable outcomes are communicated. The forthcoming years will be crucial in unlocking the potential of BE/BG, through the cumulative impact of targeted research, continuous support to industrial development and deployment, and the streamlining of administrative procedures and funding instruments.

However, a limitation of the study carried out by the literature review can be observed. It has considered scientific contributions published on a 9 years basis, from 2010 to 2019, by matching "Blue Economy" OR "Blue growth" AND "Economic Development" keywords. Neverthless, far-reaching impacts of BE/BG in relations to economic development are expected in the coming years as the world is increasingly ocean-oriented than land-oriented, as reported by Jouffray et al. (2020). This would eventually be further stimulated by the UN Ocean Decade initiative and actions that will last till 2030. So will scientific literature flourish by building on such impetus. New matches of keywords emerging from recent and coming scientific literature from different fields should be approached in order to favor interdisciplinary future avenues of research that BE/BG advocates and needs, ultimately fine-tuning ecosystem dynamics with sustainable economic development and societal needs. Examples and suggestions of keywords to be matched with BE/BG include "governance", "marine ecosystems", "ecosystem dynamics", "interdisciplinary approach", "ocean decade", "ocean stewardship", "marine spatial planning".

With regards to future research agendas, the wider public discussion should be encouraged with regards to several aspects. Among others, risk mitigation of BE/BG expansion when it comes to environmental assets has to be assessed. For this, fine-tuning assessment and operations should be carried out to leverage on the wealth generated from ecosystems dynamics of the vast ocean untapped resources without compromising them. More coordinated efforts towards knowledge export from interdisciplinary research and global science must be pursued as to favor site-,[37] sector-specific actions based on a common agreed definition and principles of BE/BG. International research collaboration between top scholars, academicians, practitioners, activists, sectoral experts, local community and policy-makers should be strongly promoted to identify regenerative models embodied by the BE/BG. Early career researchers and professionals, but also students should be involved. Capacity should be built and start from school. This would further develop the needed ocean literacy that along with innovation and technology advancement are the sole guarantees of the

[37] For "site", social, economic and geographical assets and characteristics are considered.

sustainability of the business as well as the knowledge transfer model, ultimately allowing for job creations and opportunity and, in the long term, the knowledge transfer and innovation-seeking approach from generation to generation. For this to be successful, geopolitical tensions that impact on higher education relations should be mitigated, preferably avoided, at the institutional level for the sake of a shared global science and business expertise platform with worldwide benefits for the survival and progress of human society while safeguarding the 'blue' environmental assets and ecosystem dynamics. van der Wende at al. (2020) provide an invaluable resource for both scholars and policy-makers in higher education in this sense.

Finally, BE/BG is not a one-size-fits all concept. Instead, it is an adaptable framework that can be customized and applied differently across regions and to provide the most benefit to the stakeholders in each case. The role that regional characteristics play in determining the state of the BE/BG potential emerged from this work, highlights an additional element to be added to the relation between BE/BG and regional economic development: how existing institutions (e.g. firms and public institutions) and relevant stakeholders operate in a context of economic, and ecological, transition. Applied research thorough real case studies, surveys with diverse groups, in-depth qualitative interviews with scholars, university staff and stakeholders, including entrepreneurs, citizens and policy makers could be conducted to investigate paths through which understanding how the current state of the BG/BG has come to be, thus providing the possibility to identify regional strengths and weaknesses. Moreover, a dynamic framework for identifying the changing factors in the status quo and their role within the transitions process (in our case, towards the development of a BE/BG), should be fostered.

The hope is that such future avenues of research will contribute towards a better understanding of the various definitions, as well as a heightened awareness of the policies, constraints of, and possibilities within, the concept. More awareness hopefully will lead to enhanced communication among colleagues and across disciplines and to the convergence towards an operational definition of BE/BG necessary to create comprehensive science-based policy that delivers net social and economic benefits as well as benefits the aquatic environment, in particular marine systems.

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Chapter II

Blue Economy and the Quadruple Helix Model: the Case of Qingdao

2.1 *Introduction*

Blue Economy (BE) is a novel approach fostering the sustainability of oceans and coastal areas for economic growth (World Bank 2017). By involving national and global governance (Wenhai et al. 2019), BE has become an enabler for achieving sustainable and inclusive development (Upadhyay and Mishara 2020). Due to its global implications, BE is gaining recognition among different economies, including China where starting from 2011 BE has become part of the economic development plans of the country. However, the process of transformation into a sustainable society driven by BE requires technological advances and new forms of collaboration between a wide range of stakeholders (Keen et al. 2018; Lee et al. 2020). Precisely, innovation systems need to go beyond a Triple Helix (TH) model based on collaboration between government, industry and university (Etzkowitz and Zhou 2006) and must include a fourth helix represented by the civil society (Carayannis and Rathmatullin 2014). Above all, the importance of oceans in the economies is calling for new efforts to generate international and domestic partnerships. Following the definition of McKinley et al. (2019), according to whom BE is a platform for the participatory development and protection of the marine environment, BE in China is analyzed through the collaborative lenses of the Quadruple Helix (QH). Therefore, the paper contributes to the emerging literature on a "participative" BE by understanding how the involvement of multiple stakeholders, including civil society, can drive its development.

Through desk research and semi-structured interviews with eight experts, the development of BE is explored by adopting an innovative model that considers the relationships among QH actors as a potential driver for connecting the country to foreign players. The QH model is applied to Qingdao, which is a leading Chinese city for BE's development included in the Shandong Blue Economic Zone (BEZ). The proposed research aims at understanding if there is a QH model in Qingdao's BE, and if and how this system is promoting foreign relationships. The findings show that Qingdao leverages on a strong TH under the guidance of the government, while there are no initiatives involving civil society. Furthermore, the case points out that maritime clusters hold a key role in promoting partnerships at the international level based on the exchange of knowledge between academia and industry.

Firstly, the development of BE in China is presented, then literature evidence supporting the conceptual model is reviewed. Secondly, after explaining the methodology, the results are discussed. Lastly, the implications of the study and conclusions are considered.

2.2 *Theoretical background*

2.2.1 *The Development of Blue Economy in China*

While oceans continue gaining importance for international trade, BE has become a used term to capture the goals of supporting economic development while safeguarding ocean health (Keen et al. 2018). Therefore, BE expresses the inherent conflicts between the growth and protection of ocean resources (Voyer et al. 2018). In such a scenario, political institutions in charge of BE policy are identifying human activities that can support BE development (Garland et al. 2019), especially considering the Sustainable Development Goals (Lee et al. 2020).

Already in 2014 developing nations met in Abu Dhabi to explore the BE approach within the UN Sustainable Development Knowledge Platform. Based on the discussion, a document including a "framework for sustainable development" was presented. The participating nations stated that safeguarding the socioeconomic development from environmental degradation is at the basis of BE and that the value of the blue capital in the economy should be assessed (United Nations 2014). Since then, BE has gained recognition at the global level confirming the role of the ocean in many of the global challenges faced by the planet, such as food security and climate change (OECD 2016).

In this context, China quickly embraced BE logics recognizing that the high pollution and the overuse of natural resources were causing environmental degradation. Based on the most recent Marine Environment Bulletin of China's State Oceanic Administration (2014a), large parts of coastal areas and territorial seas are severely polluted.[1] Furthermore, fish landings in China's coastal areas are decreasing due to the overuse of near-shore fisheries (Ying 2013). As a second factor, China became aware of the opportunity offered by 9000 miles of coastline, linking the North Korean border to the Vietnamese border. Coastal regions are essential components for the Chinese "economic apparatus" since Deng Xiaoping's reform and opening-up of China's borders in 1979. Since then, China's coastal regions are considered one of the most economically developed and populated areas in the world, accounting for 20% of China's land area, 40% of the population and 60% of GDP (Wang 2016). Firmly conceived as "gates" from which China should achieve a prosperous society, 40 years later the Chinese economic model has developed becoming the second largest global economic power in terms of GDP.

Leveraging on these factors, in 2003 the State Council issued the first guideline document for the development of the national marine economy "An Outline of the Planning of National Marine Economy Development," which claimed a Gross Value-Added for the ocean economy, respectively,

[1] Pollution linked to nitrogen and phosphate runoff created algal blooms and related dead zones in China's estuarine areas, ultimately provoking the death of marine life due to lack of oxygen over the years (State Oceanic Administration 2014a), while oil and gas production is continuing to damage the marine environment (Cara 2010).

of 4% of GDP in 2005 and 5% in 2010 (Song et al. 2013). Then, the National Marine Industrial Development Plan of 2008 discussed the strategic role that the Chinese Authorities allocated to the marine industry as a crucial contributor to China's socialist modernization (State Oceanic Administration 2008). In the following decades, China's marine economy reached these targets, and the value of Chinese marine activities was estimated at 9.87% of GDP in 2008 (Song et al. 2013).

The government's focus on BE dates to the 11th Five-Year Plan (2006-2011) and Beijing's strategic economic development plan, including data covering the marine economy (People's Republic of China 2006). The performance during this period registered an annual growth of 13.5% with 33 million jobs in 2010 (China Briefing 2013). As presented by the State Oceanic Administration (2014b), the country's BE consists of different economic sectors, ranging from fishing, shipping, oil and gas production to tourism. Additionally, the search for new organisms, known as marine bioprospecting, continued to provide insights to the pharmaceutical and cosmetic industries. Over 2012, the share of GDP from China's marine economy increased by 7.6% (Conathan and Moore 2013) with tourism accounting for a great part of BE (35%) while activities for resource exploitation such as oil and gas grew only at 0.1%. On the contrary, ocean mining increased by 14% (Conathan and Moore 2013) and marine bioprospecting grew by 21% (China Briefing 2014).

In the Chinese Communist Party Work Conference of 2014, China's leaders promised to continue developing the country's marine economy, confirming its importance in the country's economic development strategy (State Oceanic Administration 2014c).

Analogously, the 12th Five-Year Plan for National and Social Development (2011-2015), issued by the State Council, included a specific goal for BE to make up 10% of GDP by 2015 (China Briefing 2013). Thus, 2011 represents an unprecedented step for China to release a "Five-Year-Plan" in which "developing the ocean economy" is presented as a major national strategy for economic development. The targets specified that the rate of R&D expenditure should reach 2% of the total output value for the marine economy (China Briefing 2013). In this regard, the plan stated that scientific planning should be promoted or supporting the marine industries. As reported by Zhao et al. (2013), the plan focused on ensuring the sustainable usage of marine resources based on the improvement of marine management and marine environmental protection. Moreover, to further promote the development of seawater desalination and marine biomedicine, two national plans were released.

Lastly, the 13th Five-Year Plan for Economic and Social Development restates the importance of ensuring the development of BE. For encouraging industrial development, the Plan proposes restoring the marine ecological environment and safeguarding the sustainable development of water fishery (Wenhai et al. 2019).

BE presents relevant differences comparing the Western and Chinese approaches. If the former focuses on environmental sustainability as the innovative marine model, the latter integrates the development of coastal and marine resources in the country's economic development plans. This strategic position is confirmed in the National Marine Functional Zoning Plan, seeking for improving the coordinated development of land and sea resources. The Plan initially released by the State Council in 2002 sets "land-sea coordination," or "lvhai tongchou" (陆海统筹), as the fundamental principle of coastal areas (State Oceanic Administration 2012).

Above all, China's marine industry is recognized as a strategic source for enhancing the competitiveness of the country. However, nowadays China is in a critical moment shifting from high-speed to high-quality development and faced with tight resource constraints and damaged ecosystems.

The Chinese government has taken the road of sustainable development in line with the "New Normal" strategy (Jiang et al. 2020). In March 2018, China experienced a huge institutional reconstruction and introduced a major reform of the State Council focusing on environmental improvements that impact BE. In particular, the paradigm of ecological civilization based on the respect of nature was established and found concretization in the institution of the Ministry of Natural Resources (Wenhai et al. 2019; Chang and Li 2019).

2.2.2 *The Strategic Role of Blue Economic Zones*

China has been further encouraging scientific innovations in the marine industry by establishing six national marine economic innovation and development demonstration areas and seven national industrial demonstration technology bases (Wenhai et al. 2019). Moreover, the building of super-ports and the expansion of port cities as special economic zones has become a cornerstone of China's marine economic strategy (Henderson 2019).

In this scenario, the Blue Economic Zone (BEZ) emerged as a new concept of eco- nomic zone in China, defined as a community system supporting the development of the economy, environment and technology (Liu et al. 2018). BEZs are recognized as the first regional development strategy fostering economic coordination between marine and land resources.

In this regard, as part of the 11th Five-Year *Plan Marine Economic Development Strategy of 2011*, the State Council released five ocean economic development zone plans for Guangdong, Shandong, Zhejiang, Fujian and Tianjin. The purpose was to introduce new sustainable development approaches for China's coastal regions that were specialized in marine economic activities (Zhao et al. 2013). The Chinese State Department selected the five provinces as marine economic development pilot test zones and carried out development plans of eleven ocean economic development zones, which became national strategies in China.

Moreover, as part of the 11th Five-Year Plan *Marine Economic Development Strategy* of 2011, the State Council issued the "Blue Economic Zone" plan for the Shandong Province, which was focused on the coastal city of Qingdao and on boosting its GDP (Conathan and Moore 2013).

According to Wenhai et al. (2019), the Shandong Peninsula BEZ is expected to become an international marine industrial cluster, a leading reference for marine science, a pilot zone for national marine economic reforms and a national demonstration zone for marine ecological civilization.

Since 2015, Shandong Peninsula BEZ has set up a system of innovative marine industry by strengthening its innovation capability in marine Science & Technology (S&T), improving the quality of the ecological environment and the landscape for opening marine economy at the global level. By 2020, the Shandong Peninsula is expected to become a strategic BEZ, highly acknowledged for its marine economy and harmonious co-existence between nature and humans.

The State Council also authorized an expansion of the BEZ identified as the "Qingdao West Coast New Area." This area was appointed for sustaining a regional BE of 1 trillion yuan by 2020 acting as a hub for sea and offshore exploration (China Briefing 2014). In this paradigm, industries involved in the maritime sector are highly encouraged to operate in geographic contiguity in the so-called Blue Tech. These approaches are expected to promote economies of scale for the component sector, reaching more effectively consumers and clients (Conathan and Moore 2013).

Furthermore in 2018, numerous marine industrial parks located in the Yangtze River Delta region formally agreed to enhance regional cooperation (Wenhai et al. 2019). The marine industries in the Yangtze River Delta include five parks and bases located in Shanghai Pudong, Ningbo, Nantong, Zhoushan. A strategic cooperation was introduced for improving industrial cooperation, managing industrial projects and boosting marine industry clusters. The cooperation is focused on encouraging scientific innovation and talents advancing cooperative research between industry-academia (Chinese State of Council 2014). Given the importance of BEZs, researchers have proposed frameworks to measure their industrial competitiveness (Yan et al. 2015). Yan et al. (2015) found that competitive coastal regions can drive marine industries in confining regions by sharing social resources. Moreover, further research on the Chinese BEZ has confirmed the role of the Shandong Peninsula as the most dynamic area in resources (Wang et al. 2015) and the most affluent in marine research and education (Yan et al. 2015).

However, when investigating BE in China, accessible data on ocean-related activities are still lacking. Data on socio-economic development and the environmental impacts of policies are the basis for ensuring a sustainable ocean and coastal management and for decision-making on maritime policy.

2.3 *A Quadruple Model for the International Exposure of Blue Economy*

The shift toward a sustainable society in line with the BE approach calls for fruitful knowledge exchange between stakeholders from different fields (Grundel and Dahlström 2016). Collaboration among suppliers, producers, users and processors is the basis for designing innovative practices and products in BE (De Maeyer and Bonne 2015). Notably, the blue technology sector is benefiting from the collaboration between providers of infrastructure, including sensor and equipment manufacturers (Spalding 2016), and research centers specialized in marine science and technology (Mónica et al. 2014). S&T structures specialized in safeguarding marine ecosystems are creating new opportunities for collaboration among research communities and private-sector stakeholders (OECD 2019). Fontes et al. (2019) in presenting the case of BE in Portugal showed that research organizations often intermediate between research and industry to develop application-oriented activities. Instead, Lambrou (2016) reviewing the development of maritime clusters, discussed their role in fostering innovation abilities and transferring knowledge between stakeholders. Moreover, Sarker (2018) considering the case of Bangladesh found that the involvement of stakeholders, including civil society, researchers, NGOs, governmental officials and businesses, can improve cooperation and make maritime data publicly accessible. Furthermore, the involvement of users can be beneficial for integrating blue technologies and analyze their socio-economic implications (Alam et al. 2020). However, as underlined by Sarker et al. (2018), ocean literacy among stakeholders must be improved for achieving effective and sustainable use of the ocean.

Thus, BE should be viewed as a participatory and integrated platform (McKinley et al. 2019) where stakeholder engagement is recognized as the pillar for knowledge sharing. In this field, Burgess et al. (2018) call for holistic management of blue growth based on citizens' engagement. This means that the typical TH involving government, academia and industry requires the participation of the civil society in a QH (Carayannis and Rathmatullin 2014), which is already part of the European framework on BE (De Vet et al. 2016).

This bottom-up approach is in line with the assumption according to which citizens can contribute to changes in a society based on new consumer behaviors (Grundel and Dahlström 2016). Even if the role of users and citizens has been often underestimated their involvement can influence production models and technological progress (Etzkowitz and Zhou 2006). However, if the participatory process is not handled well, it can create a feeling of disappointment among participants (Flyvbjerg 2003). Thus, for an active BE, it is necessary to have a strong political will focused on ensuring the sustainability of marine and coastal environments and communities (McKinley et al. 2019).

Looking into the case of China, as presented in the previous paragraphs, the government has identified BE as a national development strategy (China Briefing 2013) foresing the definition of specific objectives and activities involving research and industries. While the TH has already been considered as a framework for investigating how China is balancing economic growth and sustainability (Zhou 2011), there is yet no evidence of using a QH model for understanding the development of BE.

Regarding the involvement of civil society, it must be noticed that until 2015, no domestic NGOs focusing on marine or fisheries management were present in the country (Fabinyi and Neng 2014). Moreover, fisheries and ocean environmental issues are rarely covered by Chinese media (Fu et al. 2013). Environmental civil society started to become visible in 2003 with the support of environmental NGOs (Yang 2005).

However, due to its global implications, the integration of QH models for BE must also consider the role of international stakeholders (Rivera 2006). The ocean governance framework is increasingly involving a complex network of international and regional agreements, including intergovernmental and civil society organizations (UNCTAD 2014).

In their presentation of BE cases, Wenhai et al. (2019) revealed the need for strengthening the sharing of technology, human capital and data on BE at the international level through collaborative public and private partnerships. Fontes et al. (2019) suggest that international cooperation in BE through research projects can contribute toward broadening the organizations' knowledge base and extend international networks. However, to enable international collaboration, it is necessary to improve "ocean literacy," promoting the exchange of know-how, technological standards, experiences and best practices on maritime innovation.[2]

Looking into the international dimension of BE, China holds an influential role with respect to how other countries practice it (Young 2017). Furthermore, based on the 21st Century Maritime Silk Road, China is expected to promote ocean cooperation strengthening linkages with countries along the Road. Plans will be focused on building the blue passage of the China-Oceania-South Pacific. Another blue passage is expected for connecting Europe via the Arctic Ocean.

Moreover, in July 2018, the European Union signed an ocean partnership with China to work together to improve the international governance of oceans. The partnership fosters business-to-business interaction and exchanges of information between enterprises, research institutes, financial institutions and industrial associations. With regard to the fourth helix, Chinese environment NGOs

[2] EU and China Partnership on Oceans. Available at: https://ec.europa.eu/fisheries/eu-and-china-sign-landmark-partnership-oceans_en.

are enhancing the visibility of civil society responding not only to political conditions but also to opportunities offered by the media and international NGOs (Young 2005).

2.4 *Methodology*

The research explores the Chinese BE through an original QH system, conceived as a driver for boosting foreign exposure as represented in the conceptual model (Figure 1[3]). The model considers the role of BE in connecting government, enterprises, academia and civil society while boosting the international ties of the country toward a foreign QH. The exploratory study aims at understanding if and how a QH system can be applied to China by considering the role played by each actor, and if and how this system is promoting relationships with other international actors, identifying modes connecting the domestic and international systems.

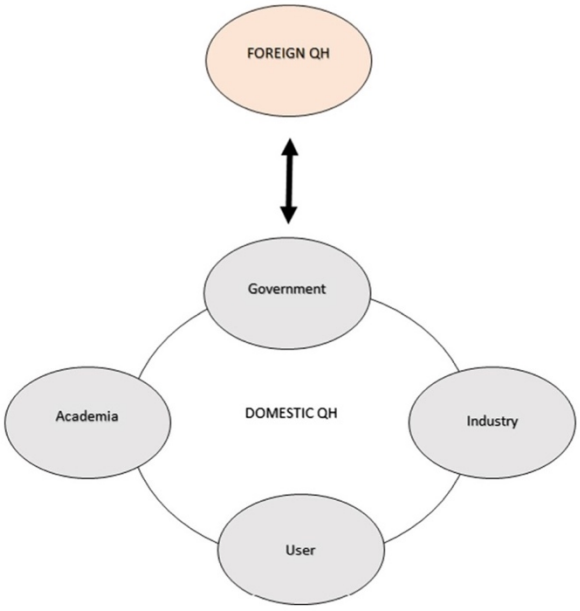
The QH model is applied to Qingdao, included in the Shandong BEZ. The city was selected for its leading role in the Chinese ocean economy and for its industrial parks (China Briefing 2014). These aspects may reveal the intention to connect domestic players in an international environment, as typically found in technological and science parks (Compagnucci et al. 2020; Eckardt 2017).

The overall contribution tries to answer the subsequent questions:

(1) R.Q.1—How do government, industries, academia and civil society collaborate in the context of BE?

(2) R.Q.2—Is this collaboration leveraging on foreign exposure?

Figure 1: Blue Economy Quadruple Helix international.



Source: Author's own elaboration.

[3] Figure adapted in compliance with the layout of the thesis.

Table 1: Interviews.

Institution/Enterprise	N. of interviews	Period
Ocean University of China	5	April 9–12, 2019
Shandong marine economic and cultural research institute	2	April 16, 2019
Daozhixian	1	May 1, 2019

Source: Author's own elaboration.

Data are retrieved through desk research based on information from Chinese and English press and scientific publications. In addition, semi-structured interviews of one hour took place with n. 5 experts from the Department of International Economy and Trade, School of Economics, Ocean University of China (中国海洋大学经济学院国际经济贸易系), n. 2 experts from the Shandong Marine Economic and Cultural Research Institute (山东省海洋经济文化研究院), and n. 1 manager of Daozhixian (岛之鲜) a state-owned enterprise of abalones and sea cucumbers processing products. The study followed the methodology of the exploratory expert interview. This methodology is sustainable to gain knowledge and orientation in hardly known areas of research (Bogner and Menz 2009). The interviews included a first part focused on the domestic QH, reviewing the role of government, industries, academia and civil society while a second part considered the international exposure of BE.

As shown in Table 1,[4] the semi-structured interviews were conducted between April–May 2019 in Qingdao for providing an answer for the R.Q.

2.5 *Findings*

2.5.1 *Qingdao Quadruple's Helix*

The development of Qingdao's BE is based on the 11th Five-Year Plan for Marine Economic Development Strategy. The Plan introduced the first Blue Economic Zone in Shandong, centered around Qingdao (Xie 2013). Since then, as highlighted by the interviews, BE rose to national strategy. China's BE has a long history, putting forward the concept of the marine economy from the late 1970s:

> *"Blue Economy can rise to national strategy due to the strong development of the marine economy. Unlike other countries, in China there is a clear difference*

[4] Table adapted in compliance with the layout of the thesis.

between bottom-up and top-down, where the lower levels strictly follow what is proposed at the central government level."

Expert from Shandong Marine Economic and Cultural Research Institute.

The BEZ aims to build a modern marine industrial system based on science and education. Qingdao represents the base of competitive industries specialized in ocean equipment, production and medicine. The role of BE for industries was confirmed by the manager of Daozhixian who is involved in the provincial "Marine RANCH Project." The project is based in the sea area near the Huangdao district in Qingdao, 5 km offshore, and is integrating marine sightseeing, fishing, fish farming, bottom-down scallop farming and other business projects. He underlined that the project is based on new production modes:

"The coastal environment on which the project is based was protected, and space is no longer occupied by aquaculture production. The area consists of a three-dimensional marine space: it includes a variety of production and operation activities, increased income per unit area, and improved economic efficiency while protecting the environment. Space can be used to develop tourism, yacht industry and other production projects that do not destroy the ecological balance."

This is true for Rongchuang Yacht Club, located on the Starlight Island. The Starlight Island is an area dedicated to film and television culture industries, while the yacht club is located behind a high-quality hotel. The Yacht Club is a circular sea area surrounded by stone dams, docking dozens of yachts, the most expensive of which is over 100 million yuan. According to the manager, the ecological balance is respected:

"The environmental management of the area is strict. Although the yacht burns diesel oil, it will not leak fuel into the sea. All kinds of sewage and garbage on yachts are not allowed to be discharged into the sea. Therefore, the activities of yachts will not pollute the seawater here."

Referring to innovation in the BEZ, there is a complete industrial chain based on innovative drugs, biomedical materials and biological products (Zhang 2018). An interesting space for BE industries is the West Coast New Area. The Area approved by the State Council will become a hub supporting a BE of 1 trillion yuan by 2020 (China Briefing 2014). Already in 2010, the Qingdao Municipal Government signed a strategic agreement with the Shandong Marine Investment Company. The agreement established that marine shipping companies must be considered as a core investment. Moreover, the company is investing in major sectors including transportation and

logistics, manufacturing, energy and mineral resources, biotechnology, culture and tourism (Yang 2010). Other areas for marine industries are related to Qingdao Marine High-tech Zone. The zone is building a marine technological service zone based on three main industrial parks: Marine Biological Industrial Park with projects on marine functional health food; the Marine Industrial Park, built to attract investments; the Marine Logistics Park, planning to create an e-commerce project platform. Instead, in 2017, the Jiaozhou Bay National Ocean Park was approved, becoming China's largest semi-enclosed bay-type national ocean park. (Guo 2019). Further, the industries of Qingdao are exploring connections with academia through a govern- mental plan for building a Blue Silicon Valley, which is an R&D center for marine science (Xie 2012). The center is set to become a coastal ecological complex, integrating administrative services and businesses. The intention is to build a nation's center of oceanographic research and technology commercialization (Ying 2014). The Blue Silicon Valley is advancing in technologies, including installations, generators and marine biomass energy. Projects are underway also for building a leisure life circle to attract talents. However, as confirmed by the interviews:

"The Blue Silicon Valley is an ongoing project itself."

Expert from Shandong Marine Economic and Cultural Research Institute.

According to the latest plan of Blue Silicon Valley Core Area, by 2060 the area will include two thousand researchers. Currently, blue research is developed in Qingdao through 7 national ocean research organizations and 5,000 professionals specialized in ocean areas. A Pilot National Laboratory for Marine S&T was initiated by 5 universities and R&D institutes in Shandong for implementing the "Transparent Ocean" project that allows the ocean below 2000 m to become more transparent. Transparent Ocean means acquiring marine environmental information in real time, predicting changes in marine environments based on 3D observation (Lian 2019). As for civil society, the research did not retrieve information on practices for increasing public awareness or involvement of civil society:

> *"Residents in the Blue Silicon Valley do not play a significant role, rarely participate in it. They can participate in services or construction but cannot participate in scientific and technological cooperation being the industrial sectors of Blue Economy of high technological value."*

Expert from Shandong Marine Economic and Cultural Research Institute.

However, a promising area where future development can be expected is the North Jiaozhou Bay Park of Qingdao High-tech Zone, which is attempting to build not only a cluster of innovative industries but also a demonstration area promoting ecological civilization. Marine Eco-civilization as

an approach seeking greater harmony between humans and nature is a national priority supported by the 13th Five-Year Plan of SOA.

2.5.2 *Qingdao's Foreign Exposure*

As underlined in the Development Planning of Shandong Peninsula BEZ (2011), the Central Government plans to undertake several internationally competitive services to support Qingdao's BE. Efforts are expected through a market diversification strategy in Japan, South Korea, Europe and the US, while expanding in emerging markets, referring to the Association of Southeast Asian Nations and Latin America. A strategy for enhancing trade through S&T and supporting enterprises to expand their brands will be implemented. Moreover, a "going out" strategy allowing preferential policies to enterprises will be promoted. In this scenario, industrial parks and clusters play a critical role in fostering international collaborations. This is the case of Qingdao International Economic Cooperation Zone, which is a manufacturing industry cluster, attracting technological parks as the China-Japan-Republic of Korea Innovation Industrial Park for BE. Academia is a further driver promoting international collaborations, starting from the Blue Silicon Valley, which intends to be a demonstration zone of marine circular economy with clusters of sustainable marine industrial groups.

Further projects refer to the introduction of new clusters specialized in marine medicines and biological products, as the National Biology Industrial Base and Qingdao Blue Bio-medical Industrial Park. In these clusters, the Blue Silicon Valley plans to establish an industry technological alliance based on R&D organizations and professionals specialized in seawater desalination, including foreign R&D centers. Furthermore, the Pilot National Laboratory for Marine S&T of Qingdao is based on strong capabilities of global scientific investigation, scientific research and transformation (Guo 2019). Moreover, the Development Planning of Shandong Peninsula BEZ of 2011 increased the support of overseas high-level talents with the "Thousand Persons Program" and overseas training programs for marine science and education personnel, setting overseas students' pioneering parks. The China Ocean Economic International Talent and Industry Academy Research Cooperation Conference was held in Qingdao in 2014 and was attended by high-level overseas professionals and enterprises. The conference, whose theme was "Attracting overseas talent and promoting the Blue Economy," obtained investments of over 3.1 billion yuan from the robotics industry, nanometer materials and environmental protection on energy sources. A similar event is represented by the Qingdao China International Ocean Summit Forum of 2014, with the theme of "Recruiting global intelligence to boost the Blue Economy" including more than 500 experts from 13 countries and international organizations. Furthermore, in 2016, the Aoshan Euro-Asia Technology Forum was hosted inviting representatives from the European Marine Energy Centre (EMEC) in the UK to

discuss the creation of a Chinese CMEC. In the same year, the Conference for the Association of Sino-Russian Technical Universities took place. The event aimed at enhancing technological cooperation between China and Russia. In 2018, the city also hosted the 18th China-Qingdao Conference on BE International Professionals and Industry-Academia-Research Cooperation. However, at the current stage, no references are provided for civil society, even if changes are expected. The Chinese SOA General Office highlighted its interest in learning from the European experience on developing an ocean culture and raising public awareness of the seas. Moreover, as emerged from the interviews:

> *"There is a need to create the basis for a common language when comparing the Chinese and foreign blue economies. Scientists, policy makers, businesspeople, and the larger society need to become precise and transparent in their language to effectively work together. Increasing communication between those working on Blue Economy is of utmost importance, considering the different backgrounds of those involved."*
>
> Expert from the Ocean University of China.

Therefore, discussion of the meanings and implications of BE is needed. Awareness can lead to convergence in the definition of BE at the global level, which is necessary to create a comprehensive science-based policy able to deliver social and economic benefits.

2.6 *Discussion*

The research explored China's BE through an innovative QH model able to boost the foreign exposure of the country in this specific domain. To this purpose, the paper considered how different players are involved in BE development reviewing their domestic and international connections. These aspects were investigated in Qingdao, selected for its leading position in the BEZ of the Shandong Peninsula. The results of the analysis, combining desk research with the interviews of experts, underlined the strategic role of governmental policies in fostering the development of the blue industrial and research system.

Furthermore, the findings show the emerging role of clusters in ensuring connections between industry and academia in line with the assumption of Lambrou (2016). Moreover, clusters in Qingdao are exploiting international collaboration in innovation with foreign industries and research centers.

International ties were found particularly in the Blue Silicon Valley, through international events attracting international talent and businesses. Such events answer to the need for more international collaboration on talent and technological development as expressed by Wenhai et al. (2019). However, contrary to the European model, Qingdao shows lacking structures promoting the

participation of civil society, keeping its distance from the bottom-up approaches (De Vet et al. 2016). However, the recent partnerships of Qingdao with European research centers could favor the shift toward a QH model, exploiting the Chinese concept of ecological civilization based on ensuring a harmonic co-existence between humans and nature.

2.6.1 *Implications of the Study*

The research contributes to the emerging literature on BE as a participative platform, following the definition of McKinley et al. (2019). Specifically, an innovative QH model is presented as a framework for comparing collaborative strategies for BE development. By applying the model to the case of Qingdao, the research sheds light on the role of clusters as industry-academia connectors that can support BE innovation also by promoting international ties with foreign industries and research centers. As for policy implications, the research stressed that the involvement of stakeholders is fundamental to provide marine policy makers and planners with accessible information on the marine economy both at the local and national level. The collection of data and insights from different stakeholders are necessary to ensure effective management and conservation of marine resources. These results contribute to the extensive literature on stakeholders' engagement for BE development (Grundel and Dahlström, 2016; Lambrou 2016; Sarker et al. 2018). Furthermore, based on the Chinese experience, involving civil society requires first awareness of BE issues and then the definition of action plans to include them in the decision-making processes.

An approach may be to embrace the inherent ambiguities of the BE concept as an opportunity for ensuring flexibility and adaptability when applying the fourth helix model. In this regard, establishing common research and innovation trajectories for implementing actions pursuing a sustainable marine and maritime growth within dedicated policy frameworks does not mean solely to apply and exploit newly achieved knowledge, it implies instead establishing multiple connections and continuous adaptation to create new value, extend knowledge frontiers, and support innovative solutions, and ultimately contribute to a participative BE (McKinley et al. 2019). For these reasons, sharing best practices among maritime economies that have experience in participative BE needs to be further encouraged.

2.7 *Conclusions*

The analysis of Qingdao through an innovative QH reveals that the city is still lacking in finding ways to incorporate the civil helix as a fourth helix. This model could instead bring greater social benefits by empowering citizens who are not only passive consumers of content/services but take on the role of creators of innovation. Although China is forerunner in approaching BE logics

already with the 11th and 12th Five-Year Plans thanks to the highly innovative and technological rate of the BE industrial sectors (in contrast to a more recent European interest), the scope of engagement and involvement of the civil society remains limited. This emerges from the innovative approach that the scientific contribution of this paper wanted to offer: the application of a typical Western explanatory model (QHM) for analyzing the Chinese context.

The discussion raised from the case study underlined the need to further investigate and compare collaborative perspectives in BE development. Nevertheless, the research is based only on qualitative data linked to desk research and interviews for a sample of experts. Therefore, it is necessary to validate the findings incorporating a qualitative methodology aimed at verifying the impact that domestic and international relationships on BE have on Qingdao competitiveness.

As for future avenues of research, the QH acting as an enabler for international exposure may represent a base for comparing the development of other Chinese BEZs and, to a larger extent, for investigating other international cases of BE. The comparison between cases would be useful for sharing best practices and foresting a common language on BE. Under this scenario, the spillover of novel research ideas on how to best integrate the fourth helix to the social and economic development agenda that the BE represents on a global scale is fascinating and it will be critical for future research to explore whether the four helixes of the BE can co-exist in practice.

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Chapter III
China's Response to the United Nations Ocean Decade

3.1 *Introduction*

This year marks the beginning of what the United Nations (hereinafter referred to as UN) hopes will be a pivotal decade for the global ocean. The UN is mounting a massive operation to try to raise awareness of the many problems it faces, and to harness the scientific research needed to solve them. Called the UN Decade of Ocean Science for Sustainable Development, the campaign has been in the planning stages for some time. Much remains to be finalized – not least the formal choice of which specific issues to address, and finding ways to do so. The project's motto is "The science we need for the ocean we want", which is driving the publishing of calls for ideas for programmes, projects or activities that could be carried out under this banner. Historically, science has been based on curiosity and discovery. Now the world needs science that is oriented and practical and focused on solutions. In this regard, the UN Decade of Ocean Science for Sustainable Development represents an important UN resolution to promote sustainable ocean development as well as the most important global marine science initiative in the coming decade that will exert a far-reaching impact on the progress of marine science and global marine governance.

China, which plays an increasingly significant role in international development and cooperation, has attached great importance to the ecological protection of oceans. As we have seen in the previous Chapter, evidences on China's interest in Blue Economy and oceans are shown in the Five-Year Plan for National Economic and Social Development since 2011. Oceans are considered of great significance by Chinese political leaders to the survival and development of humanity as they breed life, connect the world and promote development. In this respect, the Chinese vision about maritime development stresses issues of cardinal significance that require international cooperation under the UN framework, which include regional peace, biodiversity, environmental protection, preservation of natural resources and safe transportation. Accordingly, since the launch of the UN resolution, various initiatives have been undertaken by China in order to uphold the cooperation-based commitment to the ecological protection of oceans and towards achieving common and shared objectives to benefit global community.

Based on a documentary analysis of official planning and strategic documents, these initiatives are unfolded in this Chapter to investigate on the Chinese response to the UN Decade of Ocean Science for Sustainable Development 2021-2030. Section 3.2 introduces and explains the rationale behind the "Ocean Decade" framework. After a brief presentation of the UN historical footprint in China, Section 3.3. reviews and addresses the Chinese commitment, policies and

strategies consistent with "Ocean Decade". The discussion in Section 3.4 sheds light on the critical issues for the realization of the "Ocean Decade" with specific reference to those that directly require actions from China. Final considerations on opportunities for cooperation between China and Europe, highlighting potential repercussions on production chains are offered in Section 3.5.

3.2 *The United Nations Decade of Ocean Science for Sustainable Development 2021-2030*

The fate of humans is linked to the fate of all living creatures. Awareness is growing of the critical state of biodiversity loss, and of the need to protect biodiversity if we are to safeguard our future. Oceans, as the planet's largest ecosystem and critical assets for protecting biodiversity and ensuring the fate of all living creatures, make no exception.

In the last several years, the UN proposed a number of multilateral processes to cope with global challenges, including the Paris Agreement, the New Urban Agenda and the 2030 Agenda for Sustainable Development. The latter, in particular, represented the occasion to make a very strong point that the ocean should have received an explicit goal, which turned out to be the Sustainable Development Goal 14 (SDG14): Conserve and sustainably use the ocean, seas and marine resources for sustainable development. Besides SDG14, the ocean is also mentioned in many of the other SDGs, such as No Poverty, Zero Hunger, Reduced Inequalities and Climate Action, etc. More recently, the value and the safeguarding of the oceans have gained global resonance in the context of the Conference of Parties in Glasgow (COP26).[1] Several panels were organized highliting the need of a healthy and productive ocean for a resilient, nature-positive and net-0 future, and the importante for investing in global science for unlocking climate actions (IOC-UNESCO 2021a).

At its 72nd session in 2017, the UN General Assembly passed a resolution sanctioning the 2021 to 2030 timeframe as the "Decade of Ocean Science for Sustainable Development", and authorized the Intergovernmental Oceanographic Commission of UNESCO (hereinafter referred to as IOC-UNESCO)[2] to take the lead in formulating an implementation plan and creating a framework

[1] The 2021 United Nations Climate Change Conference, also known as COP26, is the 26th United Nations Climate Change conference. The summit has been held in Glasgow (Scotland, UK between the 31 October and 12 November. COP26 goals are 1) Secure global net zero by mid-century and keep 1.5 degrees within reach, 2) Adapt to protect communities and natural habitats, 3) Mobilise finance, 4) Work together to deliver. More information are available on the official website: https://ukcop26.org.

[2] The IOC-UNESCO is the United Nations body responsible for supporting global ocean science and services. This organisation enables its 150 Member States to work together to protect the health of our shared ocean by coordinating programmes in ocean observations, hazard mitigation, tsunami warnings and marine spatial planning, among others. The IOC-UNESCO also provides a focus for other UN organizations and agencies with regard to ocean science, observations and data exchange. A primary focus of the IOC-UNESCO is to enable its Member States to build the scientific and institutional capacity needed to achieve the United Nations Sustainable Development Goal 14 to conserve and sustainably manage the oceans, seas and marine resources by 2030. More information are available at: https://www.oceandecade.org/about?tab=our-governance.

to facilitate transformative ocean science solutions, connecting people and our ocean (UNESCO 2021a).

In 2020, the 75th session of the UN General Assembly deliberated and approved the "Ocean Decade" Plan which officially kicked off in January 2021. The vision of the "Ocean Decade" is to build "the science we need for the ocean we want" and aims to "promote transformative ocean science solutions for sustainable development, connecting people and our ocean" (IOC-UNESCO 2018). A clean, healthy and resilient, productive, predicted, safe, accessible, inspiring and engaging ocean. It does represent an important UN resolution to promote sustainable ocean development as well as the most important global marine science initiative in the coming decade that will exert a far-reaching impact on the progress of marine science and global marine governance.

The "Ocean Decade" will provide a common framework to ensure that ocean science can fully support countries to achieve the 2030 Agenda for Sustainable Development. It is thus a 'once-in-a-lifetime' opportunity for nations to work together to generate the global ocean science needed to support the sustainable development of our shared ocean (IOC-UNESCO 2018). This means creating a new foundation across the science-policy interface to strengthen the management of our oceans and coasts for the benefit of humanity. The "Ocean Decade" will strengthen the international cooperation needed to develop the scientific research and innovative technologies that can connect ocean science with the needs of society. It will also contribute to the UN processes protecting the ocean and its resources, such as the SAMOA Pathway, the UN Convention for the Law of the Sea, the post-2020 framework for the Convention on Biological Diversity and the Sendai Framework for Disaster Risk Reduction.

The "Ocean Decade" requires the engagement of many different stakeholders to create new ideas, solutions, partnerships and applications, these include: scientists, governments, academics, policy makers, business, industry and civil society (IOC-UNESCO 2018). The ambition of the "Ocean Decade" will be achieved by the mobilisation of actors around the world who will develop, resource and implement Decade Actions to meet the "Ocean Decade" Challenges. To achieve the "Ocean Decade" vision, a wide range of partners will implement endorsed Decade Actions in the form of programmes, projects or activities over the next ten years. Proponents of endorsed Decade Actions will have the opportunity to join a highly visible, shared, global effort that builds on decades of achievement in ocean science. There will be opportunities to create new collaborations across disciplines, geographies and generations, as well as opportunities to access new sources of support.

Via the first Call for Decade Actions (No. 01/2020) launched on October 15, 2020, partners were invited to request endorsement under the Ocean Decade for transformative Decade Actions that contribute to the "Ocean Decade" vision (IOC-UNESCO 2020a) before January 15, 2021. This Call

for Decade Actions was the first of a series that will be launched as part of the "Ocean Decade". It came out before the Decade had actually started and it was really an attempt to try and see what existed in the landscapes and get some of the big foundational building blocks of the Decade in place and it focused specifically on:

1. large-scale, multi-country, transformative Decade programmes;
2. large-scale contributions of in-kind or financial resources for Decade Actions or coordination costs.

Over 200 programme proposals and over 20 contribution proposals were submitted during this initial call (IOC-UNESCO 2020a). After a thorough review process against the endorsement criteria contained in the "Ocean Decade" Implementation Plan (IOC-UNESCO 2021c), and consideration by the Interim Decade Advisory Board, more than 60 programmes and contributions have been endorsed as the first set of Decade Actions (IOC-UNESCO 2021b).[3]

Recently, the second Call for Decade Actions (No. 02/2021) was launched on October 15, 2021. The Call for Decade Actions No. 02/2021, the second of a series that will be launched every 6 months as part of the "Ocean Decade" to try to be more predictable and let the community be aware of the schedule, will focus on Decade programmes that address priority issues related to specific Challenges that are priority for the current call including:

- Challenge 1 - marine pollution;
- Challenge 2 - multiple stressors on marine ecosystems;
- Challenge 5 - the ocean-climate nexus (IOC-UNESCO 2021d).

3.2.1 *Why a Decade of Ocean Science? Historical Footprint and Premises*

One might well wonder why a Decade of Ocean Science is badly needed. With regard to the Ocean Decade Programme, two are both the main purposes and objectives behind it (IOC-UNESCO 2018). To fill the gaps in:

1. *Defining pathways for sustainable development*

As mentioned above, the ocean is the planet's largest ecosystem. It stabilizes climate, stores carbon, nurtures unimaginable biodiversity, and directly supports human well-being through food and energy resources, as well as by providing cultural and recreational services. Unfortunately, despite improved management and conservation actions, much of the ocean is now seriously degraded. As the world population will reach an estimated 9 billion people by 2050, impacts on the ocean associated

[3] All the programmes can be accessed via: https://www.oceandecade.org/resource/166/Announcement-of-the-results-of-the-first-endorsed-Decade-Actions-following-Call-for-Decade-Actions-No-012020.

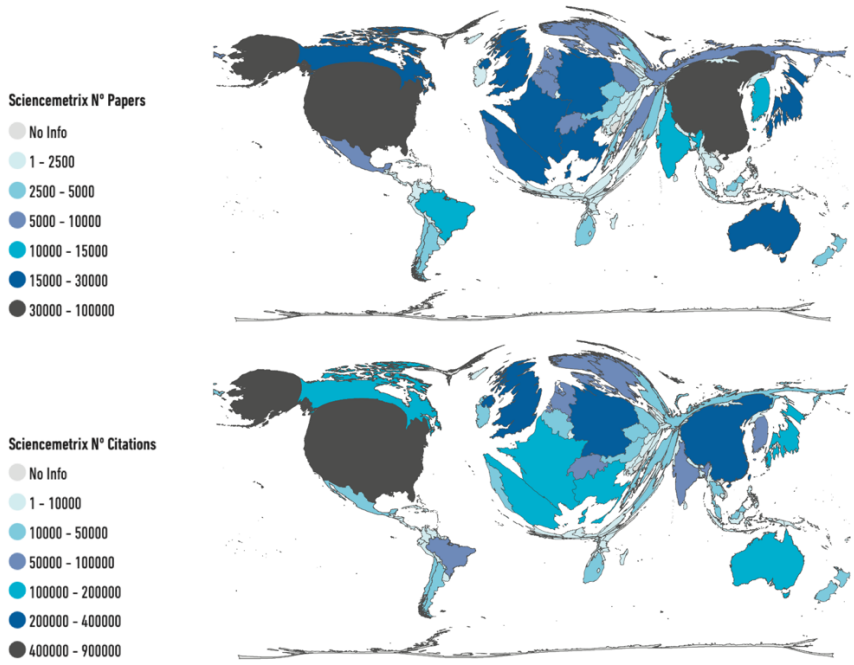
with human activities will increase. Action can only be effective if it is based on sound knowledge informed by science.

There is an increasing need to find scientific solutions that allow us to understand the changes taking place in the oceans, and to reverse its declining health. Ocean science has made great progress over the last century in exploring, describing, understanding and enhancing our ability to predict changes in the ocean system (Jouffray et al. 2020). In the coming decade, we have a tremendous opportunity to harness interdisciplinary advances in ocean science to achieve a better understanding of the ocean system. This will enable the delivery of timely information about the state of the ocean, and will allow us to define interconnected scenarios and pathways for sustainable development. Ocean science can help us to address impacts from climate change, marine pollution, ocean acidification, the loss of marine species and degradation of marine and coastal environments. To achieve sustainable development, good science is needed to inform policies, increase the knowledge of all stakeholders and ultimately deliver solutions to address the decline in ocean health.

2. *Supporting ocean science that is fit for purpose*

Global ocean science capacities are unevenly distributed. The 2017 Global Ocean Science Report found that ocean science accounts for only between 0.04% and 4% of total government research and development expenditures worldwide (IOC-UNESCO 2017).

Figure 1: Publication Map of the World according to the number of ocean science publications and citations.



Source: Global Ocean Science Report, IOC-UNESCO, 2017.

The “Ocean Decade” helps to mobilize partnerships and increase investment in priority areas where action is urgently needed. The Decade builds on existing partnerships and technologies and will create new collaborations to enhance and expand the global scientific capacity required to quickly collect issue- specific information to meet the constantly-evolving needs of ocean and coastal zone managers and a rapidly developing blue economy. While many countries benefit from sophisticated, cutting-edge scientific infrastructure, technology and human capacity for science and innovation, the 2017 Global Ocean Science Report concluded that major disparities exist in the capacity around the world to undertake marine scientific research.

A core objective of the “Ocean Decade” is to improve the scientific knowledge base through capacity development in regions and groups that are presently limited in capacity and capability, including Small Island Developing States, Least Developed Countries and Landlocked Developing Countries. Central to the “Ocean Decade” is the notion of transformation (IOC-UNESCO 2018). The Decade, both in terms of action and outcomes, needs to move beyond business as usual to a true revolution in ocean science. The transformative nature of the Ocean Decade should promote and facilitate ocean science that:

- uses the 2030 Agenda as a central framework to identify and address the most pressing societal questions related to SDG14 and related SDGs;
- is co-designed and co-delivered in a multi-stakeholder environment to be relevant and responsive across the entire value chain from knowledge generation, to applications and services to use of science for solutions;
- where needed, is audacious and forward-looking;
- spans across disciplines and actively integrates natural and social science disciplines;
- embraces local and indigenous knowledge as a key knowledge source;
- is transformative because of who is doing it or where it is being done, including in both less developed and developed countries;
- strives for generational, gender and geographic diversity in all its manifestations;
- is communicated in forms that is widely understood across society and triggers behavior change;
- is shared openly and available for re-use (IOC-UNESCO 2018).

An ocean science dimension and goals of such kind will leverage on the vision that the Ocean Decade harnesses, stimulates and coordinates interdisciplinary research efforts at all levels, in order to generate and use knowledge for the transformational action needed to achieve a healthy, safe, and resilient ocean for sustainable development by 2030 and beyond (IOC-UNESCO 2018). According

to the Ocean Decade Programme (IOC-UNESCO 2018), such vision allows for transformative ocean science solutions for sustainable development, connecting people and our ocean through a set of missions:

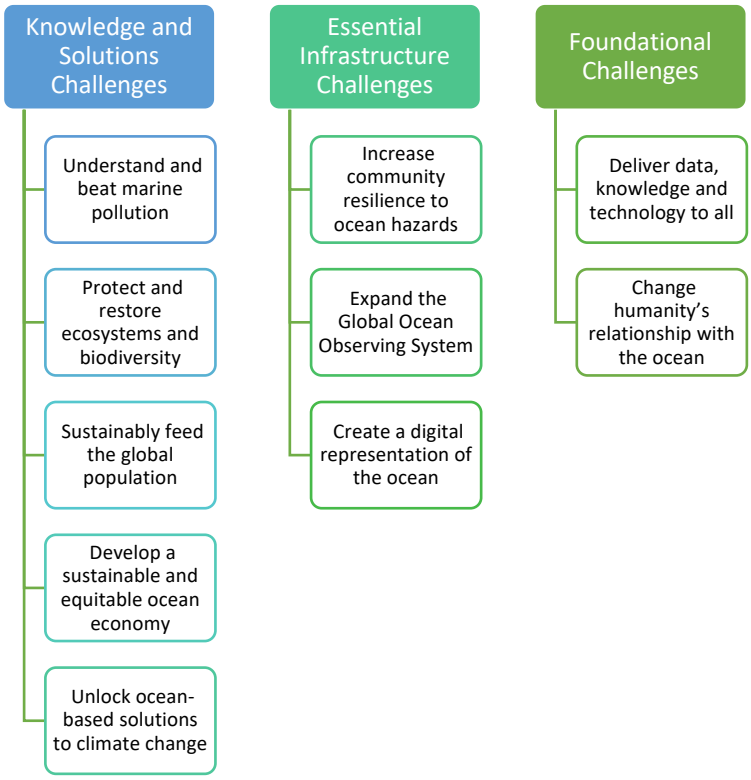
- mobilize scientists on critical ocean priorities for the 2030 Agenda;
- synthesise existing research and define trends, knowledge gaps and priorities for future research;
- co-design new research strategies with ocean stakeholders;
- bridge science, policy and societal dialogues via access to data, information and communication;
- synthesise results and develop user driven solutions;
- Foster new joint research and cooperation within and across ocean basins;

With these missions at the core of the Ocean Decade, the 'ocean we want' for a sustainable future is represented by seven Decade outcomes:

- a clean ocean where sources of pollution are identified and removed;
- a healthy and resilient ocean where marine ecosystems are mapped and protected;
- a predicted ocean where society has the capacity to understand current and future ocean conditions;
- a safe ocean where people are protected from ocean hazards;
- a sustainable harvested and productive ocean ensuring the provision of food supply;
- a transparent ocean with open access to data, information and technologies;
- an inspiring and engaging ocean where society understands and values the ocean (IOC-UNESCO 2018).

Ten Key Challenges that need to be addressed have been identified for the Decade (IOC-UNESCO 2018). Challenges may evolve throughout the Decade and new challenges will be added. Each challenge, including five Knowledge and Solutions Challenges, three Essential Infrastructure Challenges and two Foundational Challenges, contributes to one or more Decade Outcomes, as shown in Figure 2 below.

Figure 2: Key Challenges for the Ocean Decade.



Source: author's own elaboration on data from IOC-UNESCO, 2018).

As indicated in the Implementation Plan (IOC-UNESCO 2021c), a multi-step, iterative and cyclical process is required to fulfil the Ocean Decade Challenges and thus move from the 'ocean we have' to the 'ocean we want'. This process involves three non-linear, overlapping steps:

- the identification of knowledge that is required for sustainable development;
- the generation of the data, information and knowledge for the development of a comprehensive understanding of the ocean, its components and its interactions;
- the use of the generated knowledge and understanding of the ocean to deploy solutions for sustainable development (see Figure 3).

The above process requires a substantial expansion in ocean science capacity as an integral part of every step to ensure that no one is left behind during the "Ocean Decade" implementation. Increased capacity will fill current gaps in understanding of the ocean, including future conditions. It is also necessary to facilitate co-design of ocean science, co-production of knowledge and to co-deliver solutions in support of decision-making, policy, management and innovation. Expanded and equitable access to ocean knowledge, technology and services, in a form that responds to user needs, will complement capacity development efforts. Common understanding of the value of the ocean for human well-being and sustainable development is needed to achieve a step change in human behaviour and humanity's relationship with the ocean. For each Objective, a non-exhaustive list of

sub-objectives[4] is suggested that will be instrumental in the formulation, structuring and clustering of "Ocean Decade" Actions. The "Ocean Decade" Action Framework, including the Challenges, Objectives and sub-objectives, will be updated via a participatory process every two years. Yet, the sub-objectives will be reviewed and updated regularly throughout the "Ocean Decade" implementation to ensure their ongoing relevance and reflect emerging issues or changes to the Ocean Decade Challenges (IOC-UNESCO 2021c).

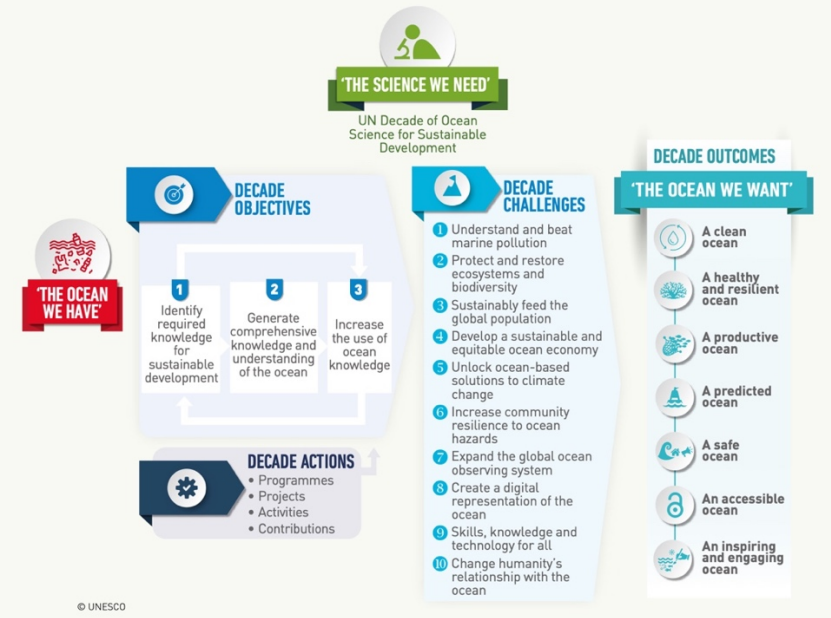
Examples of applications where the Decade Actions that will be identified, implemented and resourced by a wide range of stakeholders including national governments, regional organizations, philanthropic and corporate foundations, multilateral and bilateral funding agencies, business and industry, and individuals (e.g. via crowdfunding) (IOC-UNESCO 2021c), include:

- coastal zone management and adaptation;
- marine spatial planning/blue economy;
- destablishment of marine protected areas;
- fisheries management;
- ocean-related Nationally determined contributions to UNFCCC;
- development of national ocean policies;
- development of national R&D strategies;
- regional and national capacity development planning;
- early warning systems (IOC-UNESCO 2018).

The "Ocean Decade" Actions are the tangible initiatives that will be carried out across the globe over the next ten years to fulfil the Decade vision. These are focused on the advancement and application of knowledge to support the development of solutions and are not policy-prescriptive by nature. "Ocean Decade" Actions will be proposed and carried out by a wide range of proponents including, but not limited to, research institutes, governments, UN entities, intergovernmental organizations, other international and regional organizations, business and industry, philanthropic and corporate foundations, NGOs, educators, community groups or individuals (e.g. via community-led science initiatives) (IOC-UNESCO 2021c). Different levels of "Ocean Decade" Actions will be implemented, including programmes, projects, activities and/or contributions.[5] A comprehensive and easy-to-access framework for representing how the Decade is going to work and relations between its related Challenges, Objectives, Actions, Outcomes is offered in Figure 3.

[4] The list of sub-objectives for each Objective can be accessed at: https://www.oceandecade.org/wp-content/uploads//2021/09/337567-Ocean%20Decade%20Implementation%20Plan%20-%20Full%20Document.
[5] A technical definition of each level is available at: https://www.oceandecade.org/wp-content/uploads//2021/09/337567-Ocean%20Decade%20Implementation%20Plan%20-%20Full%20Document.

Figure 3: The Decade Challenges, Objectives, Actions, and Outcomes.



Source: The United Nations Decade of Ocean Science for Sustainable Development (2021-2030) Implementation Plan, (IOC-UNESCO 2021c).

The keywords the best describe the process behind the realization of the "Ocean Decade" are: participative and *transformative*, *consultative* and *engaging* (IOC-UNESCO 2018). As regards the formers, the "Ocean Decade" is embracing a participative and transformative process so that scientists, policy makers, managers and service users can work together to ensure that ocean science delivers greater benefits for both the ocean ecosystem and for society. The "Ocean Decade" is designed to facilitate global communication and mutual learning across research and stakeholder communities. It works to meet the needs of scientists, policy makers, industry, civil society and the wider public, but it also supports new, collaborative partnerships that can deliver more effective science-based management of our ocean space and resources (IOC-UNESCO 2018). New knowledge on the current state of ocean science will be made available to communities and governments. This knowledge will be supported through capacity development activities that will provide the tools to conduct marine science and the ability to use this knowledge to inform policy makers and wider society. As regards the latter, the "Ocean Decade" adopts a two-way, top-down and bottom-up approach. The objectives and outcomes were identified during the First Global Planning Meeting. Regional workshops were organized to explore the translation of these outcomes and objectives to the regional and national context, with the formulation of scientific products, activities and partnerships that could be proposed in the context of the Decade (IOC-UNESCO 2018).

A series of stakeholder engagement mechanisms are being designed in order to facilitate mutual learning within and across stakeholder communities and ensure robust communication within and across them. Moreover, these mechanisms' design can create stronger connections between

scientists, policy makers, managers and service users, so that ocean science delivers greater benefits for the ocean ecosystem and for society. Furthermore, it will be possible to facilitate leadership, catalyse large-scale commitments towards the Decade with targeted networking, resource mobilization and influence through the "Ocean Decade" Alliance. Lastly, convening existing or new groups of oceans actors that work together to contribute to the Ocean Decade vision through stakeholder platforms is a way to create more engagement (IOC-UNESCO 2018). The success of the "Ocean Decade" relies on the contributions of many different stakeholders including scientists, policy-makers, civil society, funders and the private sector. The boundaries between these groups are fluid and the Decade is promoting a flexible and broad approach to engagement with multiple entry points for various interests, including:

Table 1: Contributors to the Ocean Decade and their approach.

Ocean policy and sustainable development	Policy-makers from national and sub-national governments will connect ocean science activities with the 2030 Agenda.
UN entities & intergovernmental organizations	These are essential throughout the ocean science value chain: for co-design, co-delivery and use of generated knowledge, and for the provision of resources.
Business and industry	Emerging maritime businesses and ocean information providers can contribute resources and partnerships, and as a driver of technological innovation.
Donors and foundations	These will be essential to stimulating an enabling environment for the Decade that empowers communities, mobilizes partnerships and substantially increases investment in priority areas for action.
Public	Communities will engage via communication and ocean literacy activities, adapted to cultural, linguistic and geographical contexts, including access to technology.
Civil Society/NGO	This diverse group (aquariums, zoos, youth, educators, etc.) can play a multitude of roles, from generation of science to advocacy, from education to outreach with local communities.
Ocean science and technology	Scientists, research institutes, universities, technology and innovation hubs, and professional societies will benefit from increased investment and collaboration with a diverse range of partners for inter and trans-disciplinary ocean science.
Early career ocean professionals (ECOPs)	ECOPs are the next generation of ocean scientists, decision makers and innovators. They will contribute to and lead actions throughout the Ocean Decade and continue its legacy post-2030.
Media	Media partners will be essential to sharing knowledge throughout the world on how every citizen can use the results of ocean science to take action to protect our shared ocean.

Local and indigenous knowledge holders	These communities will have the opportunity to collect and store information in innovative and accessible formats that can support its preservation and dissemination.

Source: Author's own elaboration from the United Nations Decade of Ocean Science for Sustainable Development (2021-2030) IOC-UNESCO, 2018.

Generally speaking, the Decade tries to transform the current ocean science and knowledge into real solutions and to trans- form the 'ocean we have' into the 'ocean we want'. It is a once-in-a-lifetime opportunity for everyone who cares about the ocean.

3.3 *How is China responding to the UN Ocean Decade?*

3.3.1 *UN in China*

The UN has had a presence in China since 1979. Since then, the UN has had the privilege to witness the profound economic and social transformation that has taken place in China. The UN in China is currently comprised of 29 UN entities having presence in China (Table 2) (UN 2021).

Table 2: List of UN Entities in China.

Categories	Entity Names
Funds and Programmes	UNDP: United Nations Development Programme
	UNEP: United Nations Environment Programme
	UNFPA: United Nations Population Fund
	UN-HABITAT: United Nations Human Settlements Programme
	UNICEF: United Nations Children's Fund
	WFP: World Food Programme
Specialized Agencies	FAO: Food and Agriculture Organization
	ICAO: International Civil Aviation Organization
	IFAD: International Fund for Agricultural Development
	ILO: International Labour Organization
	IMF: International Monetary Fund
	UNESCO: United Nations Educational, Scientific and Cultural Organization
	UNIDO: United Nations Industrial Development Organization
	WHO: World Health Organization
	WIPO: World Intellectual Property Organization
	WBG: World Bank Group
Other Entities and Bodies	UNESCAP-CSAM: United Nations Economic and Social Commission for Asia and the Pacific – Centre for Sustainable Agricultural Mechanization
	IOM: International Organization for Migration
	UNAIDS: United Nations Programme on HIV and AIDS
	UNHCR: Office of the United Nations High Commissioner for Refugees
	UNOOSA/SPIDER: United Nations Office for Outer Space Affairs/UN Platform for Space-based Information for Disaster Management and Emergency Response

	UNV: United Nations Volunteers Programme
	UNOPS: United Nations Office for Project Services
	UN Women: United Nations Entity for Gender Equality and the Empowerment of Women
Secretariat	DPPA: Department of Political and Peacebuilding Affairs
	DSS: Department of Safety and Security
	RCO: Resident Coordinator Office
Other	UNGC: United Nations Global Compact
	UNU in Macau: United Nations University Institute in Macau

Source: Author's own elaboration from United Nations in China Annual Report, United Nations, 2021.

Over the years, the nature of the UN work in China has evolved with the changing environment. From having played the role of a traditional donor, the UN is now focusing on advising the Government on domestic development processes and China's global engagement (UN 2018). In fact, in 2020, the UN in China reported a total of US$ 136.79 million in programmatic expenditures, representing a decreasing year on year since 2018 (see Figure 4). This is in line with UN's role in China shifting from a traditional donor to a partner providing policy advice and technical expertise.

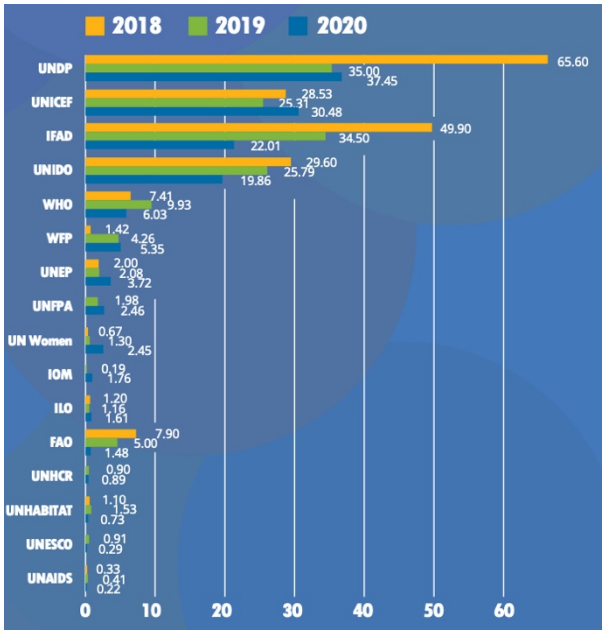
Figure 4: Total Programmatic Expenditure of the UN in China in 2018, 2019, and 2020.

Source: United Nations in China Annual Report, United Nations, 2021.

When the first UN office opened in the country in 1979, an important focus for the UN was to provide assistance for basic needs and support the Government's efforts to build the foundation for further growth and development. In the 1990s, the UN started to help with China's industrialization process and improve health and education among the population. By the 2000s, the UN's support shifted towards capacity building and enhancing the equity and quality of development, bringing the perspective of social and environment sustainability. Today, the UN is no longer a donor providing development assistance for basic needs, but a development partner that can provide advanced policy advice and share international experience. The UN's current focus is to support China's efforts to implement the UNDAF 2016-2020 and achieve the 17 SDGs both domestically and globally (UN 2021).

Same as previous years, the UN Development Programme is still the organization with the largest programmatic expenditure (US$ 37.45 million), then followed by UNICEF (US$ 30.48 million), IFAD (US$ 22.01 million) and UNIDO (US$ 19.86 million) (see Figure 5).

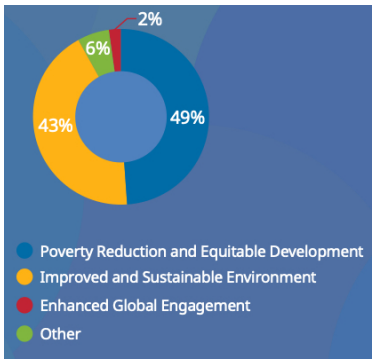
Figure 5: Programmatic Expenditure of the UN Entities in China in 2018, 2019 and 2020 (US$ millions).



Source: United Nations in China Annual Report, United Nations, 2021.

In terms of programmatic expenditures by UNDAF Priority Area, Priority Areas 1 and 2 accounted for the majority of total expenditures (49% and 43% respectively), while Priority Area 3 made up only 2% of the total expenditure (see Figure 6).

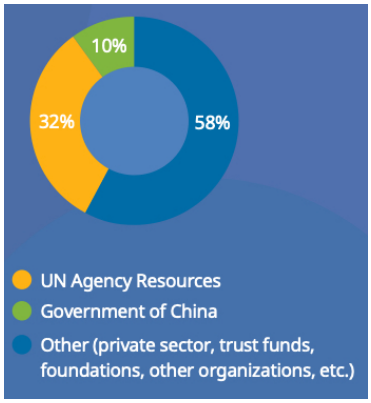
Figure 6: UN's Programmatic Expenditure in China in 2020 by UNDAF Priority Areas.



Source: United Nations in China Annual Report, United Nations, 2021.

Figure 7 shows that 32% of the UN's funding came from UN entities' own resources, 10% was funded by the Government of China; while the majority came from other sources, including trust funds, private sectors, foundations and other organizations and governments.

Figure 7: UN's Programmatic Expenditure in China in 2020 by Source of Funding.



Source: United Nations in China Annual Report, United Nations, 2021.

In 2015, the 2030 Agenda for Sustainable Development was adopted by Member States at the UN Summit for Sustainable Development. The 2030 Agenda and the 17 Sustainable Development Goals call for concerted efforts towards building an inclusive, sustainable and resilient future for people and planet. To facilitate its implementation in China, the UN works together to provide integrated support to China by sharing high-level policy inputs, supporting normative work and promoting global exchanges, including the development of Belt and Road Initiative, collaboration among BRICS member states and other South-South Cooperation (UN 2018).

The 75th anniversary of the UN occurred during a time of unprecedented global health crisis, which has undermined the hard-won progress and achievements on the 2030 Agenda for Sustainable Development and Sustainable Development Goals (SDGs). The SDGs are not just a lofty ambition. Their fulfilment is essential to the recovery, flourishing—and, ultimately, the survival—of all humanity (UN 2021). In the words of Mr. Siddharth Chatterjee, who has started his new role as the UN Resident Coordinator in China in 2021, there are less than ten years left for the world to keep its promise of meeting the SDGs. Such a task will require committed political leadership, sound public policy, and strong partnerships. Here, China can play a vital role and has the resources and experiences to contribute mightily to the achievement of the SDGs (UN 2021). He further argued that in 2021, the UN embarks on the UN Sustainable Development Cooperation Framework 2021-2025 for China, in alignment with the 14th Five-Year Plan. In this new cycle of cooperation, the UN will also flip the orthodoxy and unlock new forms of finance as we forge partnerships with stakeholders from the private sector and foundations, harness frontier technologies and address development challenges within the South-South Cooperation framework, with a particular focus on the African continent. Leveraging China's resources, experiences and expertise, and boosting their capacity, to support the achievement of the SDGs for everyone, everywhere, will ensure the UN in China lives up to the Secretary-General's vision, to be fit for purpose and deliver as one (UN 2021).

3.3.2 *China's Commitment to the "Ocean Decade"*

Chinese President Xi Jinping has attached great importance to the ecological protection of oceans. The ocean is considered of great significance by Chinese political leaders to the survival and development of human society. It gave birth to life, connects the world, facilitates development and, as such, we need to care for the ocean as we treasure our lives (Xinhua, 2021, a). President Xi Jinping has, on various occasions, called for strengthening cooperation in protecting the oceans, and his proposal of building a maritime community with a shared future has gained worldwide resonance (Xinhua, 2021, b). Oceans are of great significance to the survival and development of humanity as they breed life, connect the world and promote development, Xi said on April 23, 2019, during the meeting with the heads of foreign delegations invited to multinational naval events marking the 70th founding anniversary of the Chinese People's Liberation Army Navy (Xinhua, 2021, b). As reported by Xinhua (2021, b), Xi said that the blue planet humans inhabit is not divided into islands by the oceans, but is connected by the oceans to form a community with a shared future, where people of all countries share weal and woe. Moreover, on the relationship between the oceans and humanity he once commented that the ocean does not separate our blue planet into isolated continents; instead, it links the peoples of all countries to form a global community of shared future that remains bound together through thick and thin (Xinhua 2021c; Xinhua 2021d).

At present, ocean-based cooperation in market, technology, information, culture, and other areas is steadily deepening, Xi said, noting that the reason for China to propose jointly building the 21st Century Maritime Silk Road is to facilitate maritime connectivity, pragmatic cooperation in various fields, and the development of the blue economy, as well as to promote the integration of maritime cultures and to improve maritime wellbeing. President Xi bolstered this concept by quoting a Chinese saying which goes by: "the ocean is vast because it admits all rivers (*hǎinàbǎichuān* 海纳百川)." Whenever a problem crops up, countries concerned should always hold deliberations in good faith, rather than resort to the use or threat of force at will (Xinhua 2021d). George Tzogopoulos, director of the EU-China programmes and senior research fellow at the International Center for European Studies, strengthened this argument by affirming that the Belt and Road Initiative contributes to organic interconnectivity across the world (Xinhua 2021b). However, he furtherly argued that China's vision about maritime development goes beyond this kind of connectivity into issues of cardinal significance that require international cooperation under the UN framework, which include regional peace, biodiversity, environmental protection, preservation of natural resources and safe transportation (Xinhua 2021b).

Accordingly, since the launch of the "Ocean Decade", various initiatives have been undertaken by China in order to uphold the abovementioned cooperation-based commitment and towards achieving common and shared objectives to benefit global community.

The year 2020 was an extremely challenging year for China and the world. The COVID-19 pandemic has posed a great threat to the lives, health, safety and wellbeing of people. It has disrupted global efforts to achieve the 2030 Agenda for Sustainable Development and threatened to reverse years of progress on the attainment of the Sustainable Development Goals (SDGs). It was critically important for China as it was the last year for the implementation of the 13th Five-Year Plan for Economic and Social Development and the foundation year for the preparation of the 14th Five-Year Plan. Therefore, the Chinese People's Political Consultative Conference and the National People's Congress of 2020, often dubbed as "Two Sessions", were extremely significant in the juncture of two FYPs and amid the COVID-19 crisis. Response to COVID-19 and accelerating the post-pandemic recovery thus became a predominant topic during the "Two Sessions" of 2020.

At the end of 2020, China eradicated extreme poverty by lifting the remaining 5.51 million rural poor out of poverty (UN 2021). Such a result cannot be achieved without sound economic development. In fact, China's economy grew by 2,3%, presenting itself as the only major economy with a positive economic growth last year. Moreover, in the pursuit of long-term sustainable development, China also worked towards turning the swift recovery to a green one, in line with its consistent efforts in prioritizing the protection of the environment. In the UN General Assembly of September 2020, China's President Xi Jinping announced that China would adopt more vigorous policies and measures and pledged to have CO2 emissions peak before 2030 and achieve carbon neutrality before 2060 (UN 2021).

Globally, China plays an increasingly significant role in international development and cooperation. South-South and Triangular Cooperation (SSTC), and the Belt and Road Initiative (BRI) remain major mechanisms supporting China's goal of helping other developing countries to implement the 2030 Agenda for Sustainable Development. China has also developed a strategy in international health cooperation to tackle the COVID-19 crisis, including making Chinese vaccines a global public good. These national development agendas, including COVID-19 response, poverty reduction, economic and social sector reform, green recovery and ecological restoration, and international development cooperation strategy are aligned with the three priority areas of the UN Development Assistance Framework (UNDAF) 2016-2020 for the People's Republic of China: 1) Reduction of Poverty and Equitable Development; 2) Improved and Sustainable Environment; and 3) Enhanced Global Engagement (UN 2018).

3.3.3 *China's Initiatives consistent with the "Ocean Decade"*

1. Marine development in the context of China's 14th Five-Year Plan

Evidences on China's interest in Blue Economy and oceans are shown in the *Five-Year Plan for National Economic and Social Development* since 2011 (hereinafter referred as FYP or the Plan). As analyzed by Sampaolo et al. (2021), the 12th FYP (2011–2015) represents an unprecedented step for China to release a "Five-Year-Plan" in which "developing the ocean economy" is presented as a major national strategy for economic development and where scientific planning should be promoted for supporting the marine industries. Later, the 13th FYP restates the importance of ensuring the development of Blue Economy (Sampaolo et al. 2021).

2021 marks the beginning of China's 14th FYP covering the years 2021-2025 (中华人民共和国国民经济和社会发展第十四个五年规划和 2035 年远景目标纲要), as passed the Two Sessions last March (The State Council of the PRC 2021). It is particularly noteworthy as it traces the first five years of the new Chinese development path towards achieving its first 100 years' goal as a Xiaokang Society (小康社会), generally translated as a moderately prosperous society, and towards the achievement of its second 100 years' goal: the 100-year period since the foundation of the People's Republic of China (PRC). The next five years also constitute a critical period of strategic opportunities for China to explore and test new development models amid significant changes both domestically and internationally. Although the 14th FYP contains relatively few quantitative targets, it details a vast array of near-term PRC economic, trade, S&T, defense, political, social, cultural, environmental, and other policy priorities. The 14th FYP differs from past plans in that it also includes a short section on "long-range objectives" for 2035.

In the brief foreword of the Plan, with regards to the core areas of national security and development where strategic scientific programmes and projects are to be developed and implemented, among others – artificial intelligence, quantum information, integrated circuits, life and health, brain science, biological breeding, air and space science and technology, and deep earth – the deep-sea is conceived as a frontier where major national science and technology projects of a forward-looking and strategic nature will be implemented. In particular, the focus is on the promotion of innovative development concerning marine engineering equipment, which is included in the "Livelihood Improvements" paragraph of the "Frontiers of Science and Technology" (科技前沿领域攻关) section (The State Council of the PRC 2021).

However, these rather technical and engineering indications aside, Article XXXIII "Actively expand the space for maritime economic development" (积极拓展海洋经济发展空间) of the Plan's Part 9 "Optimize regional economic layouts and promote coordinated regional development" (优化

区域经济布局 促进区域协调发展) sheds light on and provides a ground floor for a deep understanding and observation of China's commitment to marine development and thus, to blue economy.

> 坚持陆海统筹、人海和谐、合作共赢，协同推进海洋生态保护、 海洋经济发展和海洋权益维护，加快建设海洋强国。
>
> *To adhere to land and sea coordination, harmony between humans and the sea, and mutually beneficial cooperation, coordinate and promote marine ecological protection, maritime economic development, and maritime rights maintenance, and accelerate the construction of a maritime powerhouse.*

The importance of harmony between human and sea emerge as the focus of the introduction at the beginning of Article XXXIII, stressing the need to adhere to land and sea coordination in order to protect the ocean while developing economically.

In Section I "Build a modern maritime industry system" (建设现代海洋产业体系):

> 围绕海洋工程、海洋资源、海洋环境等领域突破一批关键核心技术。培育壮大海洋工程装备、海洋生物医药产业，推进海水淡化 和海洋能规模化利用，提高海洋文化旅游开发水平。优化近海绿色 养殖布局，建设海洋牧场，发展可持续远洋渔业。建设一批高质量 海洋经济发展示范区和特色化海洋产业集群，全面提高北部、东部、 南部三大海洋经济圈发展水平。以沿海经济带为支撑，深化与周边 国家涉海合作。
>
> *The Plan will make breakthroughs in a number of key and core technologies in areas such as marine engineering, marine resources, and marine environment. It will cultivate and expand the marine engineering equipment and marine biotech and pharmaceutical industries, promote seawater desalination and the large-scale utilization of marine energy, and improve the level of maritime cultural tourism development. It will optimize the layout of offshore green aquaculture, build marine pastures, and develop sustainable pelagic fisheries. It will build a number of high-quality maritime economic development demonstration zones and specialized maritime industry clusters and comprehensively improve the development levels of the three major maritime economic circles in the north, east, and south. With the support provided by the coastal economic belt, it will deepen maritime cooperation with neighboring countries.*

This excerpt emphasizes the numerous key and core technologies to build China's modern maritime system. Additionally, maritime cultural tourism development is also highlighted as an important element to be cultivated. Lastly, the section stresses the will to build maritime economic development demonstration zones and specialized maritime industry clusters in order to connect all economic circles in the country. Still, cooperation is crucial also when it comes to neighbors countries.

In Section II "Build a sustainable marine ecological environment" (打造可持续海洋生态环境), at home, China, at home, will bolster controls of land-source ocean pollution, with river basins, river mouths and coastal waters to come under unified management with the so-called "land and sea coordination" approach reported above in the foreword of Article XXXIII, and the scope of caps on land-source pollutants to be expanded to ensure river water quality. Ultimately, this work needs to be reflected in improvements to coastal environments and ecologies, and in five years the Ministry of Ecology and Environment (MEE) will assess progress as part of a national "Beautiful Bays" campaign which is described in details below:

> 探索建立沿海、流域、海域协同一体的综合治理体系。严格围填海管控，加强海岸带综合管理与滨海湿地保护。拓展入海污染物 排放总量控制范围，保障入海河流断面水质。加快推进重点海域综 合治理，构建流域—河口—近岸海域污染防治联动机制，推进美丽 海湾保护与建设。防范海上溢油、危险化学品泄露等重大环境风险， 提升应对海洋自然灾害和突发环境事件能力。完善海岸线保护、海 域和无居民海岛有偿使用制度，探索海岸建筑退缩线制度和海洋生态环境损害赔偿制度，自然岸线保有率不低于 35%。
>
> *The Plan will explore the establishment of a comprehensive management system that integrates coastal, river basin, and marine areas. It will strictly control land reclamation and strengthen integrated coastal management and coastal wetland protection. It will expand the scope of control over the total discharge of pollutants into the sea and ensure the water quality of river sections entering the sea. It will accelerate the comprehensive governance of key maritime areas, establish a river basin-estuary-coastal waters linkage mechanism for the prevention and control of pollution, and promote the protection and construction of beautiful bays. It will prevent major environmental risks such as marine oil spills and hazardous chemical leaks and improve our ability to respond to marine natural disasters and environmental emergencies. It will improve the coastline protection system and sea area and uninhabited*

> *island paid use system, explore the receding line system for coastal buildings and the compensation system for marine ecological environment damage, and maintain the retention rate of natural shoreline at no less than 35%.*

The establishment of a comprehensive management system emerges as the focus of this excerpt. Safeguarding the sea from pollution and preventing environmental risks are the goals to achieve, including coastline protection.

Interestingly, Section III "Deeply participate in global ocean governance" (深度参与全球海洋治理) marks a vigorous shift from the previous FYP approach. As a matter of fact, the Plan highlights China's willingness to a more proactive engagement with regards to a "in-depth participation in global ocean governance", prompting the establishment of a "fair and reasonable international ocean regime" and the development of "blue partnerships" as well as the construction of an "ocean community with a shared future for mankind." Furthermore, Section III also launches the "Ice Silk Road" shipping route in the Arctic, alongside increasing capacities to participate in governance and utilization of the Antarctic (Jiang and Shi 2021):

> 积极发展蓝色伙伴关系，深度参与国际海洋治理机制和相关规则制定与实施，推动建设公正合理的国际海洋秩序，推动构建海洋命运共同体。深化与沿海国家在海洋环境监测和保护、科学研究和海上搜救等领域务实合作，加强深海战略性资源和生物多样性调查评价。参与北极务实合作，建设"冰上丝绸之路"。提高参与南极保护和利用能力。加强形势研判、风险防范和法理斗争，加强海事司法建设，坚决维护国家海洋权益。有序推进海洋基本法立法。

> *The Plan will actively develop blue partnerships, deeply participate in the formulation and implementation of international ocean governance mechanisms and related rules, promote the construction of a fair and reasonable international maritime order, and promote the construction of a maritime community of common destiny. It will deepen practical cooperation with coastal nations in the fields of marine environmental monitoring and protection, scientific research, and maritime search and rescue and strengthen the survey and evaluation of deep-sea strategic resources and biodiversity. It will participate in pragmatic cooperation in the Arctic and build the "Ice Silk Road". It will improve China's ability to participate in the protection and utilization of Antarctica. It will strengthen situational research and judgment, risk prevention, and legal theory struggles, strengthen judicial construction for maritime*

affairs, and resolutely safeguard national maritime rights and interests. It will advance legislation concerning basic maritime law in an orderly manner.

Moreover, Section I of Article XXXVII "Improve the quality and stability of ecosystems" (提升生态系统质量和稳定性) included in the Plan's Part 11 "Promote green development and facilitate the harmonious coexistence of people and nature" (推动绿色发展 促进人与自然和谐共生) is centered to "Improve the ecological safety barrier system" (完善生态安全屏障体系) of China:

强化国土空间规划和用途管控，划定落实生态保护红线、永久基本农田、城镇开发边界以及各类海域保护线。以国家重点生态功能区、生态保护红线、国家级自然保护地等为重点，实施重要生态系统保护和修复重大工程，加快推进青藏高原生态屏障区、黄河重点生态区、长江重点生态区和东北森林带、北方防沙带、南方丘陵山地带、海岸带等生态屏障建设。加强长江、黄河等大江大河和重要湖泊湿地生态保护治理，加强重要生态廊道建设和保护。全面加强天然林和湿地保护，湿地保护率提高到 55%。科学推进水土流失和荒漠化、石漠化综合治理，开展大规模国土绿化行动，推行林长制。科学开展人工影响天气活动。推行草原森林河流湖泊休养生息，健全耕地休耕轮作制度，巩固退耕还林还草、退田还湖还湿、退围还滩还海成果。

The Plan will strengthen control over the spatial planning and use of the nation's land and delineate and implement ecological protection red lines, permanent basic farmland, urban development boundaries, and various marine area protection lines. It will focus on national key ecological function areas, ecological protection red lines, and national nature reserves, implement important ecological system protection and restoration major projects, accelerate the construction of ecological barriers in the Qinghai-Tibet Plateau ecological barrier zone, the Yellow River key ecological zone, the Yangtze River key ecological zone, the northeast forest belt, the northern sand control belt, the southern hilly and mountainous zone, and the coastal zone. It will strengthen the ecological protection and management of major rivers such as the Yangtze River and the Yellow River as well as important lakes and wetlands and strengthen the construction and protection of important ecological corridors. It will comprehensively strengthen the protection of natural forests and wetlands and increase the wetland protection rate to 55%. It will scientifically advance the management of soil erosion, desertification, and rocky

desertification, carry out large-scale land greening campaigns, and promote the forest director system. It will scientifically carry out artificial weather modification activities. It will promote the recuperation of grasslands, forests, rivers, and lakes, improve the fallow cropland rotation system, and consolidate the achievements of restoring farmland to forests and grasslands, restoring farmland to lakes and wetlands, and restoring enclosures to beaches and seas.

This excerpt shows an emphasis on all actions to endorse to better build an ecological safety barrier system, also concerning coastal zones, lakes, beaches and seas.

As highlighted in Section II "Build a nature reserve system" (构建自然保护地体系), the conservation of biodiversity, the protection of nature reserves and various protected areas are the focus of the system, whose policies will regulate land and sea use:

科学划定自然保护地保护范围及功能分区，加快整合归并优化各类保护地，构建以国家公园为主体、自然保护区为基础、各类自然公园为补充的自然保护地体系。严格管控自然保护地范围内非生态活动，稳妥推进核心区内居民、耕地、矿权有序退出。完善国家公园管理体制和运营机制，整合设立一批国家公园。实施生物多样性保护重大工程，构筑生物多样性保护网络，加强国家重点保护和珍稀濒危野生动植物及其栖息地的保护修复，加强外来物种管控。完善生态保护和修复用地用海等政策。完善自然保护地、生态保护红线监管制度，开展生态系统保护成效监测评估。

The Plan will scientifically delineate the scope of protection and the functional zoning of nature reserves, accelerate the integration and optimization of various protected areas, and build a nature reserve system with national parks as the main entities, nature reserves as the foundation, and various natural parks as supplements. It will strictly control non-ecological activities within the scope of nature reserves and promote the orderly withdrawal of residents, cultivated land, and mining rights in the core areas. It will improve the management system and operating mechanisms of national parks and establish a number of national parks in an integrated manner. It will implement major biodiversity conservation projects, build a biodiversity protection network, strengthen the protection of and the restoration of national key protections for rare and endangered wild animals and plants along with their habitats, and strengthen the control of invasive species. It will improve ecological protection and restoration content in policies for land

and sea use. It will refine the regulatory system for regulating natural protected areas and ecological protection red lines and carry out monitoring and assessment of ecosystem protection effectiveness.

Section III "Optimize the regional layout of opening up" (优化区域开放布局) in Article XL on "Construct a higher-level new open economy system" (建设更高水平开放型经济新体制) included in Plan's Part 12 looks at the sea as a bond that guarantees connections across borders:

鼓励各地立足比较优势扩大开放，强化区域间开放联动，构建陆海内外联动、东西双向互济的开放格局。巩固东部沿海地区和超大特大城市开放先导地位，率先推动全方位高水平开放。加快中西部和东北地区开放步伐，支持承接国内外产业转移，培育全球重要加工制造基地和新增长极，研究在内陆地区增设国家一类口岸，助推内陆地区成为开放前沿。推动沿边开发开放高质量发展，加快边境贸易创新发展，更好发挥重点口岸和边境城市内外联通作用。支持广西建设面向东盟的开放合作高地、云南建设面向南亚东南亚和环印度洋地区开放的辐射中心。

The Plan will encourage localities to expand opening up based on their comparative advantages, strengthen the opening up linkages between regions, and build an opening up layout with linkages between land and sea, inside and outside, and east and west, for bidirectional mutual benefit. It will consolidate the leading position in opening up held by eastern coastal areas and mega-cities and take the lead in promoting comprehensive and high-level opening up. It will accelerate the opening up of the central and western regions and the northeast, support them in welcoming transferred domestic and foreign industries, cultivate important global processing and manufacturing bases and new growth poles, study the establishment of national category 1 ports in inland areas, and push inland areas to become the frontier of opening up. It will promote the high-quality progress of border development and opening up, accelerate the innovation and development of border trade, and allow key ports and border cities to better play their roles for internal and external connections. It will support Guangxi's construction of a bastion of opening up and cooperation oriented toward ASEAN and Yunnan's construction of a radial center that is open to South Asia, Southeast Asia, and the Indian Ocean Rim.

Strengthening the linkages between regions, building an opening up layout between land and sea, and creating connections inside and outside the country emerge as the main focus of this excerpt. These strategies will allow China to accelerate innovation of the border trade, as well as the development of the key ports and border cities.

In Section IV "Build bridges for mutual learning and appreciation of civilizations" (架设文明互学互鉴桥梁) of Plan's Part 41 on "Promote the high-quality joint development of Belt and Road" (推动共建"一带一路"高质量发展) among others – which include wildlife protection, and desertification prevention and control, and promote the construction of the Green Silk Road – the 14th FYP seeks to strengthen exchanges and cooperation in addressing climate change and marine cooperation:

> 深化公共卫生、数字经济、绿色发展、科技教育、文化艺术等领域人文合作，加强议会、政党、民间组织往来，密切妇女、青年、 残疾人等群体交流，形成多元互动的人文交流格局。推进实施共建"一带一路"科技创新行动计划，建设数字丝绸之路、创新丝绸之 路。加强应对气候变化、海洋合作、野生动物保护、荒漠化防治等 交流合作，推动建设绿色丝绸之路。积极与共建"一带一路"国家开展医疗卫生和传染病防控合作，建设健康丝绸之路。
>
> *The Plan will deepen humanistic cooperation in the fields of public health, digital economy, green development, S&T education, and culture and art, strengthen interchanges between parliaments, political parties, and private organizations, intensify exchanges between women, young people, the disabled, and other groups, and form a diversified and interactive humanistic exchange pattern. It will promote the implementation of the "Belt and Road" S&T innovation action plan and build a Digital Silk Road and an Innovative Silk Road. It will strengthen exchanges and cooperation in climate change response, maritime cooperation, wildlife protection, and desertification prevention and control and promote the construction of a Green Silk Road. It will actively carry out cooperation with countries participating in "Belt and Road" construction in healthcare and infectious disease prevention and control and build a Health Silk Road.*

2. *China' special first Five-Year Plan for National Marine Ecological Environment Protection*

President Xi Jinping is now more focused than ever on turning China into a maritime power. He has repeatedly made instructions on this and it has been included as part of the "two centennial goals" (Deng and Zhong 2020; Xinhua 2021a). Protecting the marine environment has been an

integral part of this grand strategy. As a matter of fact, the above selected excerpts of the 14th FYP are consistent with a broader agenda that Chinese policymakers have set when it comes to the marine domain. On the occasion of the 19th National Congress of the Chinese Communist Party in 2017, creating a "Beautiful China" by 2035 has become a goal to achieve also including a dedicated plan for the environment (Shi 2021).

To this regard, on March 25, 2020, following President Xi Jinping's instructions regarding the relevance of carrying out solid investigations and research, finding out noteworthy problems as well as scientifically planning target indicators, main tasks, policies and measures, the MEE held a working meeting on the selection of pilot plans useful to help with the preparation of the "*14th Five-Year Plan for National Marine Ecological and Environmental Protection*" (全国海洋生态环境保护"十四五"规划), which is expected this year (Shi 2021). To reveal it, the Ministry of Ecology and Environment (MEE) has called upon Jinzhou, Lianyungang, Shanghai and Shenzhen to draft their own pilot plans (Ministry of Ecology and Environment of the PRC, 2020). The Bohai Sea, Yellow Sea, East China Sea and South China Sea are the seas where those four cities lie on, from north to south. According to The Paper's report (2020), over 6,000 locations have been surveyed for the drafting of their own FYP, including 784 coastal bays. The meeting's participants pointed out that the "*14th FYP for National Marine Ecological and Environmental Protection*" is the first FYP in the field of marine ecological environment protection after institutional reforms, and it is a key document to guide marine ecological environment protection in the coming period (Ministry of Ecology and Environment of the PRC 2020). In fact, Shi explains that parts of China's coast have been damaged over the years by land reclamation, pollution and other factors (2021). Over the past 70 years, human activity has gradually chipped away at China's natural coastlines, with only about 33% of the coast remaining undamaged in 2014, according to research using satellite imagery (Shi 2021). That has reduced marine biodiversity and prevented people coming into close contact with the ocean. This means they have been "near, but disconnected, from the ocean, or having only low-quality experiences" of it, according to Guan Daoming, former director of the MEE's National Marine Environmental Monitoring Centre, which is in charge of technical aspects of drafting the FYP (Shi 2021).

This is the reason why the "Beautiful Bay" campaign will allow people to enjoy the sea. This campaign will look at water quality, as well as the recovery of marine life and habitats and the protection and restoration of natural coastlines to ensure all 1,467 of China's bays are "beautiful" by 2035, in line with the overall 2035 Beautiful China goal (Shi 2021). In compliance with the MEE, the "Beautiful Bay" campaign will feature as a target in the special 14th FYP for National Marine Ecological and Environmental Protection – the first such document to be drafted – with all 1,467 of

China's ocean bays to be certified by 2035. Improving the environment in Chinese waters is also of benefit to the global ocean (Jiang and Shi 2021).

Even if they were not included in the survey, the city of Dalian and Zhejiang Province have released their own marine environment protection FYPs, both including types of indices for marine species based on rate of retention of natural coastline, length of restored coastline, and area of wetlands restored or protected (Dalian Municipal People's Government 2021; The People's Government of Zhejiang Province 2021).[6] In particular, Dalian's plan sets anticipatory targets for numbers of spotted seal and black-faced spoonbill, both of which are local "celebrity species" and breed in the Bohai Sea. The targets will mean ensuring the reefs and wetlands where the species breed are protected from human interference, and that they have better feeding grounds. The next five years will see China continue with ecological restoration projects designed to boost biodiversity. The upcoming marine environment FYP will set up restoration projects in 105 bays, improving 48 habitats for key species, as stated by Zhang Zhifeng, also deputy director of the MEE's Department of Marine Ecology and Environment (Shi 2021). Some wetland restoration projects have come in for criticism. In Panjin, Liaoning, migrating birds have long used the intertidal zone as a stopping place, but almost all of this has been taken over by aquaculture farms. A project is trying to turn these farms back into beaches. But when Zhou Haixiang, a member of the Chinese National Committee for Man and the Biosphere Programme, visited he found the restored areas tended to be further away from the coast and were still surrounded by the cofferdams used to enclose aquaculture farms, meaning tides did not rise and fall naturally. "And many restoration projects focus on improving the scenery, rather than the environment," said Zhou as reported by Shi (2021). As regards the Zhejiang Province, the 14th FYP for marine environment would research marine carbon sink ecosystems province-wide, looking at their distribution, condition and potential, with four cities to run blue carbon trial projects. Zhejiang, Dapeng New District and the Shandong city of Weihai are all preparing to develop "blue carbon" schemes. Wang Hong, vice minister at the Ministry of Natural Resources and director of the State Oceanic Administration, recently said that alongside the Intergovernmental Panel on Climate Change's identification of mangrove swamps, seagrass meadows and salt marshes, China plans to add other marine carbon sinks such as fisheries and marine microorganisms that function as "biological pumps", storing carbon in the deep sea.[7] Zhao Peng, associate researcher at Hainan University's State Key Laboratory of South China Sea Marine Resource Utilization, says that China has not yet done enough basic research and data-gathering on marine carbon. Carbon sequestration

[6] The full texts of the FYPs of the city of Dalian and Zhejiang Province can be accessed at: https://www.dl.gov.cn/jsurvey/jsurvey/questionnaire/jsurvey_931.html.
[7] For more insights on biological pumps please visit: https://chinadialogueocean.net/17840-cold-fish-the-global-cooling-effect-of-ocean-life/.

potential varies significantly across time and region, and depends on types of vegetation, climate and environmental impacts, so he thinks there isn't enough data yet to include marine carbon in China's work to comply with climate change treaties. "Carbon sequestration for climate change mitigation is only one small part of the ecological services provided by marine ecosystems," he says. "Marine carbon has an important role to play in our adaptation to the negative effects of climate change. We should develop a comprehensive understanding of it, and avoid exaggeration" (Shi 2021).

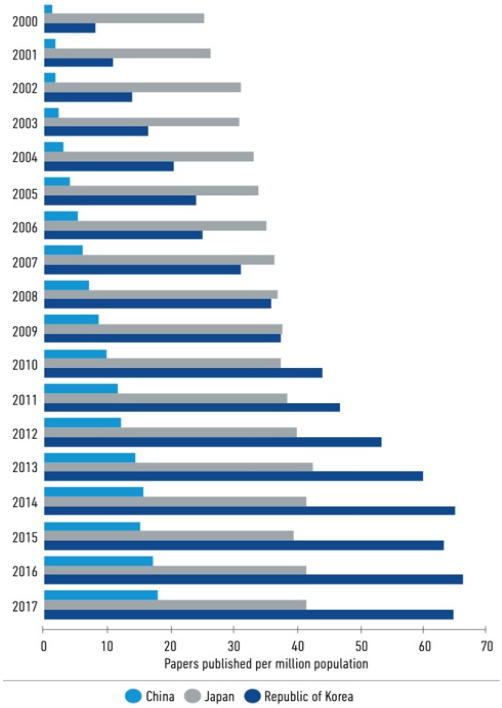
These FYPs at both the city and province levels along with the expectations for the 14th FYP for National Marine Ecological and Environmental Protection are all clear signs of China's plans to become a "maritime power" also against the backdrop of stepping up as a major and global player in the fight against climate change. Therefore, great expectations are building up with China's increasing role in the protection of the marine environment.

3. China's scientific contribution to Ocean Science

Towards the achievement of SDG14 and the others with reference to the ocean, the ocean science community plays a critical role for a huge contribution to these goals. They would like to learn more about the ocean, to support decision making, to safeguard the ocean and to help our economy to benefit from the ocean in a really sustainable way. There are many opportunities for ocean science and that is the policy backdrop of the Decade (Zhao 2021).

As Lara-Lopez et al. (IOC-UNESCO 2020b) argue, there has been an increase in the number of peer-reviewed ocean science publications, both in absolute and relative terms, in most SDG regions over the past 18 years. The most obvious change has been a 10% increase in output from the Eastern and South-Eastern Asia region, largely driven by China and to a lesser extent by Japan and the Republic of Korea. These countries experienced one of the largest changes in the scientific production landscape. Figure 5 shows that although China continues to be behind Japan and the Republic of Korea, it has maintained a sustained growth trend in the number of articles per million inhabitants throughout the period 2000-2017. However, the slope of this trend is modest, and it will take quite a long time to equal the productivity ratios of its neighbors (IOC-UNESCO 2020b).

Figure 4: Productivity of ocean science in China, Republic of Korea and Japan, as the number of scientific publications per million inhabitants.



Source: Global Ocean Science Report, IOC-UNESCO, 2020.

Furthermore, to enable comparisons of disciplinary strengths and weaknesses of national or regional research profiles, in the *Global Ocean Science Report 2020* Lara-Lopez et al. (IOC-UNESCO 2020b), disaggregated ocean science into eight different categories. These categories are: Blue growth; Marine ecosystems functions and processes; Ocean and climate; Ocean crust and marine geohazards; Ocean health; Ocean observation and marine data; Ocean technology and engineering; Oceans and human health and well-being. The Specialization Index (SI) was used as a metric for comparison between regions and between the top ten most publishing countries in ocean science (IOC-UNESCO 2020b).[8] For the same period 2000-2017, Lara-Lopez et al. (IOC-UNESCO 2020b), found that China has a high SI in the 'Ocean technology' category compared to most regions and countries across Eastern and South-Eastern Asia.

The authors also carried out a national positional analysis in ocean science by category where the number of peer-reviewed ocean science publications, the SI and the ARC were taken as indicators. The top 40 most publishing countries in ocean science were used for this analysis for three different

[8] This index gives an overview of a nation or region's research priorities or specialization. The SI indicates the research intensity of a given entity (e.g. institution, country or region) in a given research area (e.g. a category of ocean science), relative to the intensity of a reference entity (e.g. the world or the entire output as measured by the database) for the same research area. The SI for each category in ocean science is normalized to that of the world (World=1). What this means is that when an institution is specialized in a field, it places more emphasis on that field at the expense of other research areas. For example, if an SI > 1, in conclusion the entity's research in that given field is more specialized than the world average (relative to ocean science).

time periods: 2000-2005, 2006-2011 and 2012-2017 (IOC-UNESCO 2020b). Firstly, this analysis shows a trend towards the axes with time, with a less dispersed distribution in 2012-2017 period compared to 2000-2005, and an increase in the ARC of most nations. Some of the most notable changes are from China, Japan and the Republic of Korea, moving from an SI below world average towards world average. While the publication output from most of the nations represented in the analysis carried out by Lara-Lopez et al. (IOC-UNESCO 2020b) remained stable, China's output increased by one order of magnitude from 2000-2005 to 2012-2017. However, China's average relative citation (ARC) score has remained below average, although with some improvement. The authors argue that China's low ARC could be linked to language, with all the countries with an ARC below the world average being non-native English-speaking. It is likely that many of their researchers publish in national journals in their language, and this may have an effect on their impact. Indeed, adding English translation to regional journals can help increase their impact and increase collaboration with researchers from other countries (IOC-UNESCO 2020b).

With regards to 'Ocean crust and marine geohazards', China shows an SI and ARC similar to the world average, which signifies a big change compared to categories such as 'Ocean and climate' and 'Ocean Health' (IOC-UNESCO 2020b). This analysis shows how nations specialize in particular categories of research, illustrating their priorities. A remarkable change is shown by China, which increased its output by about an order of magnitude and improved its ARC, moving from a lower SI towards the world average (IOC-UNESCO 2020b).

Another relevant aspect regards collaboration patterns and capacity development in ocean science. Several studies (Pirlet et al. 2018; Franceschet and Costantini 2010) demonstrate that scientific collaboration can bring many advantages to the researchers involved by increasing their productivity through the sharing of knowledge, expertise and techniques. And that collaboration also enables people with different but complementary skill sets to come together and work as a team, dividing the workload, reducing costs by sharing equipment and resources, and enhancing the visibility of their research (IOC-UNESCO 2020b). Most important, further studies (Bozeman et al. 2015; Claxton 2005) highlight that the current scientific landscape is one of increasing collaboration because of the associated benefits, including the creation of knowledge (IOC-UNESCO 2020b).

Most importantly, science can make valuable contributions to a better understanding of the ecosystem's functioning and to identify the relevant options for its sustainability and management. Ocean science seeks to understand complex, multiscale socio-economic and bio-geo-chemical systems and services, which requires multidisciplinary and collaborative research (IOC-UNESCO 2017). This requires that fragmented knowledge, very often in distant communities, is combined to share research capacities (e.g. facilities, observation networks, transfer of know-how and data and

information exchange) in order to make real progress (IOC-UNESCO 2020b). Based on the findings of Schmalzbauer and Visbeck (2016), Lara-Lopez et al. stress that the universal nature of science and research, the speed of change and its expansion in a hyper-connected world, favoured by the development of new innovative technologies, offer the opportunity to work in cooperation within and with other countries in large projects and to participate in large research infrastructures (IOC-UNESCO 2020b). International cooperation has long been regarded as an essential aspect of public research and, nowadays, research cooperation and collaboration are now a requirement by institutions, funding bodies and policymakers and has become a rule between scientists.

In the context of this analysis, all international scientific publications, indexed in literature databases, with the participation of at least two co-authors based in institutions/organizations in at least two different countries, were counted. Data were then converted into percentages of co-publication (e.g. International co-publication rate, ICR). In order to simplify the analysis, the study was limited to the top 100 most publishing countries (which account for more than 95% of the total published scientific literature) (IOC-UNESCO 2020b). Interestingly, in the period 2012-2017, 24 countries of the 100 used in this analysis show ICR values under 50%. Although there is no clear pattern explaining these rates of collaboration, it can be observed that big countries such as Argentina, Brazil, China, India, the Russia Federation and the US, and also largely populated countries such as Indonesia, Iran, Japan, Mexico and Turkey are within this group. According to the authors, this is likely to be because they are big enough and/or have enough research facilities and networks to uphold/ enable the interchange of scientist and establish collaborations among scientific groups within their own territories (IOC-UNESCO 2020b).

To explore further some of these international collaboration links, network analysis was used by the authors to understand which nations are acting as the engines for ocean science. This analysis allows for the visualization of the collaboration intensity between nations, their preferred collaboration network as well as the evolution of these networks since 2000 (IOC-UNESCO 2020b). The analysis illustrates that industrialized nations in Asia-Pacific, Europe and the US act as the engine of ocean science research with the highest output, the strongest links and also the largest network, with the US dominating. It is evident that over time the network is expanding, and the connection among nations is growing and changing. For example, in 2000 to 2012, Canada and the US had the highest number of collaborations, accounting for ~10,000 over 12 years, while most recently, from 2012 to 2017, the highest collaboration for the US has been with China, accounting for over 11,000 in just six years (IOC-UNESCO 2020b).

With regard to institutional collaborations, institutions from Australia, Europe and Northern America have built strong links among themselves and these have remained over the years. A notable

change has been the strengthening of links between Japanese and US institutions, and Chinese institutions with the rest of the world over time. CNRS from France is the organization with by far the largest output across time, while the output from NOAA (US) has decreased and the Chinese Academy of Sciences increased. It is important to note that the State Oceanic Administration (SOA) was responsible for ocean science in China until 2018, and the Ministry of Natural Resources (MNR) thereafter.

4. *The UN "Decade of Ocean Science for Sustainable Development – Ocean Decade 2021 to 2030 – China Workshop*

In 2021, countries across the world observed the 13th World Oceans Day. On this occasion, the UN "Decade of Ocean Science for Sustainable Development" (联合国"海洋科学促进可持续发展十年**) –** Ocean Decade 2021 to 2030 – China Workshop was held in Qingdao, Shandong on 8 June 8, 2021 (FIO-MNR 2021a). It is one of the World Ocean Day and National Ocean Awareness Day activities, as well as a series of activities to commemorate the 50th anniversary of China's restoration of its legal seat at the UN. The mission, vision and goals of the "Ocean Decade" are highly aligned with the concepts and principles "Maritime community with a shared future", "Marine development by relying on science and technology" and the "New Development Concept" advocated by the Chinese government. General Secretary Xi Jinping proposed "to build a new ecosystem of open innovation that enables science and technology serve better to the mankind and let the Chinese technologies make greater contribution to building a community of shared future for the mankind" (FIO-MNR 2021a). Chinese marine scientists and workers deeply feel the importance and sense of mission of the contribution of China's wisdom and strength to the marine field. In order to actively respond to (implement) the "Ocean Decade" initiative, they would be constantly engaged to promote innovation in marine science and technology as well as the marine governance – control and management –, so as to make contribution to the sustainable development of the ocean.

2021's themes of the World Oceans Day and Ocean Awareness Day which were respectively "The Ocean: Life and Livelihoods" and "Protecting Marine Biodiversity, Harmonious Co-existence of Man and Nature", highlight the importance of oceans for the life and activities of the global community (Xinhua 2021c; FIO-MNR 2021a). The workshop was designed and held in accordance with the theme of Oceans Awareness Day. It focused on scientific frontiers such as the comprehensive understanding of technology innovation applied in ocean field, marine ecology and biodiversity protection, the contribution of ocean to carbon neutrality goals, the discovery of special deep-sea habitats and so on. The domestic scientific practices were also discussed. The workshop analyzed and proposed the action goals and implementation of China's participation to the "Ocean Decade".

As the first major event of China's participation in the "Ocean Decade", the workshop was jointly organized by the Ministry of Natural Resources (MNR-SOA), the National Natural Science Foundation of China (NSFC), and hosted by the First Institute of Oceanography (FIO-MNR). It received extensive attention and active participation from the government and all sectors of society. Ove 260 representatives belonging to more than 120 units and institution that included national ministries, local governments, scientific research institution, universities, enterprises, social organizations, and international and domestic organizations[9] participated to this large-scale workshop which was also broadcasted through Xinhua News Agency, receiving more than 300,000 views online (FIO-MNR 2021a).

Representatives from the MNR (Wang Hong, Vice-Minister of the Ministry of Natural Resources and Director of the State Oceanic Administration), NSFC (Hou Zengqian, Vice-director of the National Natural Science Foundation of China), local government (Ji Bingchang, Vice-Governor of Shandong Provincial People's Government, and Zhao Haozhi, Mayor of Qingdao Municipal People's Government) and Dr. Ryabinin, attended the meeting and, during the opening ceremony, gave their warm remarks and delivered speeches. The representatives from both central and local government of China showed their strong willingness and support to the UN Ocean Decade initiative, and highlighted that China's key research programmes and scientific plans are in line with the UN Ocean Decade priorities. Dr. Ryabinin, congratulated the convening of the conference by video, expressed appreciation for China's active participation in the "Ocean Decade". Meanwhile he expected that China could play more important role in the "Ocean Decade" and conduct and promote the organization and implementation of relevant activities. The international community recognised the effort and important role of China in advancing ocean sciences and expressed the expectation for continuous support and contribution from China to the UN Ocean Decade.

Seven invited talks were given by representatives from Chinese academicians and leading scientists, NSFC, private sectors, the UN Decade Executive Planning Group (EPG), and the WESTPAC of IOC-UNESCO.[10] It is noteworthy that the latter is been co-chaired by the China-recommended researcher Qiao Fangli since the 13th Intergovernmental Session of the IOC-UNESCO

[9] Jose Santos, Executive Director of the International CLIVAR Project Office (ICPO) sent a greeting to the event, and Ms. Jing Li and Ms. Qian Zhao attended the workshop on behalf of ICPO. CLIVAR (Climate and Ocean: Variability, Predictability and Change) is one of the four core projects of the World Climate Research Programme (WCRP). See for reference: https://www.wcrp-climate.org.

[10] Established in 1989, WESTPAC is a regional branch of IOC-UNESCO for the Western Pacific Ocean and adjacent areas, which consists of 22 member countries from East Asia and Southeast Asia as well as including the US, the UK, France, and Australia. Its main functions are to implement projects of IOC-UNESCO for global marine science and observation service in the Western Pacific region, and to initiate, promote, and coordinate projects for marine science, observation service, and capacity training suitable for the region in accordance with the common interests of the member countries in the region.

Sub-Commission for the Western Pacific (WESTPAC-XIII) held via video from April 27 to 29, 2021 (FIO-MNR, 2021, b).

The talks enlightened ideas for the potential priorities of China to the UN Ocean Decade, which may include: integrating science, management and society to support ocean sustainability (Coastal-SOS); improved understanding of oceanic and atmospheric processes through strengthened observations, model development and predictions in order to provide high-quality public services and products that can benefit the society; microbe-mediated ocean carbon negative emission processes to serve as the ocean action to achieve China's carbon neutral target; investigation and sustainable use of deep sea resources; funding priorities to promote marine science innovation in supporting global ocean governance; and ocean renewable energy exploration.

Academicians, well-known experts, government departments, industries, and non-profit organizations in related fields in China jointly discussed the scientific and international governance issues involved the "Ocean Decade", actively publicized the concept and connotation of the "Ocean Decade", demonstrated China's deep participation in marine cooperation under the UN framework, and expressed China's willingness and contribution to foster marine scientific and technological innovation and to the promotion of sustainable marine development.

During the discussion and wrap-up sessions, participants recognised that the ocean sciences needed for sustainable development cannot be limited to a decade, but should be a long-term effort. They agreed on the importance and necessity of innovative solutions to better link ocean sciences with societal needs; rising public ocean awareness; strengthened collaboration and knowledge sharing; as well as inter-disciplinary and multi-stakeholder participation.

In line with sustainability principles which are deeply rooted in the Blue Economy concept, the workshop was carbon neutral, as the 13.74 tons carbon emission estimated for organizing this workshop was offset by the blue carbon credit donated by the SEE Foundation of China, purchasing from a mangrove restoration project in Zhanjiang, Guangdong Province of China (CLIVAR 2021).

5. *Decade Actions's Transformative Programmes led by China*

Against the backdrop of the "Decade Actions", the "Ocean Decade" has endorsed three transformative programmes developed by global partnerships of ocean scientists, governments and industry to enhance coastal resilience, for both humans and ecosystems (UNESCO 2021a). The three programmes have been endorsed as part of the first set of flagship Decade Actions of the Decade that will contribute to achieving the vision of the Decade of the 'science we need for the ocean we want'. Specifically, they are based on the premises that over 40% of the global population lives within 100km of the coast, and this trend is on the rise. In the coming decades the majority of coastal dwellers will live in increasingly densely populated urban areas, which are already subject to rising sea levels,

heightened storm intensity and frequency, and elevated temperatures. The results will be flood damage, erosion, infrastructure damage, and greater pressures on social and health services due to increased environmental hazards. Concentrating the population in such narrow coastal areas requires quick action to make coastal ecosystems and communities worldwide more resilient to the changes underway.

As such, being China particularly sensitive to these issue and, at the very same time, being such issues of particular interest and concern to China with regard to the huge migration flows and concentration of extensive amounts of population in narrow coastal areas – as a result of a the urbanization process and policy started in the early '80s –, Chinese universities stepped up in the lead of two out of the three transformative programmes based on ocean knowledge to help current and future coastal communities cope with this massive challenge.

The first programme is "Mega-Delta Programme".[11] Many populated coastal areas include deltas and estuaries which provide critical habitat for many species of bird, mammal, fish and other wildlife. They are also important for tourism, fisheries and recreational activities and serve as natural filters against pollutants and can act as nature-based solutions in the fight against climate change. Delta environments are threatened by climate impacts such as erosion, flooding, and deteriorating habitats, but their health is crucial to the resilience of communities. Led by the State Key Laboratory of Estuarine and Coastal Research of East China Normal University, intends to build up a comprehensive picture of delta dynamics to inform human development, and conservation strategies. Two deltaic habitats of particular importance are salt marshes and mangrove forests. They stabilise sediment reducing the risk of flooding and preventing erosion; provide habitat for other marine species important for biodiversity, subsistence and commercial livelihoods; act as a carbon dioxide sink; and help counteract the effects of chemical pollution.

The second programme is the Global Estuaries Monitoring (GEM).[12] Urban coastal areas are major sources of these marine contaminants such as pharmaceuticals, but our understanding of pollutant distribution requires improved monitoring systems. The Global Estuaries Monitoring (GEM) Decade Programme, led by the City University of Hong Kong, will work closely with scientists, policy makers, and pharmaceutical companies around the world. By training a global network of scientists in sampling, processing, and analysing estuary data for contaminants, and collaborating with relevant stakeholders, this programme will support better knowledge and management of polluting industries.

[11] See for reference: https://oceanexpert.org/document/28725.
[12] See for reference: https://oceanexpert.org/document/28740.

Together, these programmes constitute the first building blocks of the Decade. They are supposed to lead a global Community of Practice throughout the Decade that facilitates the co-design and co-delivery of initiatives to increase ocean knowledge-based solutions and contribute to the ten Ocean Decade Challenges. Future Calls for Decade Actions will be launched throughout the Decade to stimulate actors around the world to join forces to identify, implement and resource transformative and inclusive ocean science initiatives that contribute to sustainable development solutions from the global to local scales.

6. *The "Sharing National Marine Spatial Planning (MSP) Practices Worldwide: China" seminar*

Earlier on March 17, 2021, the seminar themed "Sharing National Marine Spatial Planning (MSP) Practices Worldwide: China" was held online (FIO-MNR 2021d). It was hosted by the IOC-UNESCO and the International Cooperation Department of the Ministry of Natural Resources (MNR) and jointly organized by the First Institute of Oceanography of the Ministry of Natural Resources (FIO-MNR) and the China Oceanic Development Foundation. A total of 126 representatives from more than 40 countries and international organizations attended the seminar. The seminar aimed to advance the implementation of the Joint Roadmap to Accelerate Marine/Maritime Spatial Planning Worldwide released by the UN and provide a platform for the sharing of national MSP experience.

At the seminar, it was stated that marine functional zoning (MFZ), as the basis and main body of China's MSP, has made a major contribution to national sea area use management, marine ecological environment protection, and marine economic development in the past three decades. In recent years, the Chinese government has made great efforts to push forward ecological civilization construction, practice the concept of "maritime community with a shared future", and actively have exchanges and cooperation with other coastal countries, establishing a new model of international cooperation in MSP. In the future, China will continue to work closely with such international organs as IOC-UNESCO, as well as relevant countries, to jointly establish and improve MSP-linked techniques, methods, and systems, vigorously accelerate work related to the MSP Global 2030, and facilitate the realization of the 2030 Agenda for Sustainable Development. Experts of the China Oceanic Development Foundation, engineers of the FIO-MNR, researchers from the National Marine Data and Information Service made speeches on the practices and experience of sea use management in China, the practices and experience of MSP of China, and the ecosystem-based coastal belt protection planning, respectively, and had in-depth discussions with other attendees.

At the end of the seminar, a summary of all the speeches emphasized the importance and urgency of MSP as a tool for marine management. China has rich experience in the field of MSP and China's current territorial spatial planning system is of great help to the formulation of international

MSP guidelines. Thus, the IOC-UNESCO will further cooperate with the MNR of China and the FIO under it, in an effort to speed up the implementation of the MSP Global 2030.

As China is an important member of the IOC-UNESCO, the MNR has organized relevant domestic authorities to take an active part in the work of the IOC-UNESCO, and the FIO has been deeply involved in the planning and implementation of the MSP Global 2030. This seminar has effectively popularized China's achievements and experience in the field of MSP and demonstrated China's great efforts to strengthen global marine governance and accelerate sustainable marine development.

7. EU-China partnership sets the pace for international marine data sharing

China and Europe collaboration in the marine field has set up during the high-level conference and forum of EU-China Blue Year 2017. Later, the signing of the EU and China Blue Partnership' for the oceans in 2018 formalized the beginning of the collaborative work in the marine field (European Commission 2021a).

The projects within the Partnership that started in 2020 focused on marine data and diplomacy, namely the EMODnet PArternship for China and Europe (EMOD-PACE) for Europe, and the China-European Union Marine Data Network Partnership (CEMDNET), which can be considered as the starting point of a new phase of strategic EU-China ocean relations (European Commission 2021a). The Partnership aims to realize the interoperability of marine data and data products between China and the European Union based on the operation of the Center for Marine-meteorological and Oceanographic Climate Data (CMOC/China) and EMODnet, also focusing on ocean reanalysis, seabed habitat and ecological vulnerability. All these research activities carry out data and information about the ocean management in the fields of waterway coastal adaptability, develop relevant standards and products, promote the development of marine science and technology (National Marine Data and Information Service 2021). The ultimate goal is protecting the marine ecological environment, responding to the global climate change and to the global governance of the "Ocean Decade". A step further into the EU-China marine relations was taken in January 2021, when European Marine Observation and Data Network (EMODnet) and the National Marine Data and Information Service (NMDIS) signed a Memorandum of Understanding (MoU) to strengthen this partnership between Europe and China and to form the basis for their collaboration under the form of the two interconnected projects aforementioned, EMOD-PACE and CEMDNET (National Marine Data and Information Service 2021).

According to the press release of the European Commission (2021), the agreement consolidates the operational, technical and scientific collaboration which is already well underway, by providing a clear framework to advance the joint efforts through the EMOD-PACE and

CEMDNET projects on three specific areas of collaboration: 1) the sharing of available in-situ, earth observation and modelled marine data; 2) the exchange of knowledge and best practices related to marine data and information product R&D and associated technology; 3) the development and implementation of common work plans between NMDIS and EMODnet in relation to ocean reanalysis, seabed habitat mapping, ecological vulnerability and coastal zone adaptation (European Commission 2021a).

The EMOD-PACE and CEMDnet projects include thematics spanning sea-level ocean reanalysis, seabed habitat mapping, ecological vulnerability and coastal zone adaptability, with a focus on the maritime silk route, and with data visualization available through a dedicated map-viewer (National Marine Data and Information Service 2021). Specifically, according to the European Commission (2018), this unique collaboration to advance data-sharing and access should facilitate bilingual access to data and products currently available in European and Chinese marine data portals (EMODnet and NMDIS), as well as those developed during the project. It could also allow the creation of an interoperable marine data information systems between the EU and China and the development of a Brokerage Service for Access to available data and data products between EMODnet and NMDIS. Through this partnership, it should be possible to examine similarities and differences between European and Chinese ocean circulation models and reanalysis products. Thanks to this collaboration, it would be easier to compare European and Chinese numerical models used for seabed habitats and ecological carrying capacity by analyzing the applicability of the respective models in different areas. Furthermore, results like delivering data and information products for the 'Maritime Silk Road' on sea level changes, coastal erosion, wetland degradation and vessel traffic density, as well as finding out more about EMOD-PACE and the Maritime Silk Road seas, should be achieved (European Commission 2018).

The EMOD-PACE highlights the EU and China's belief that by working together and learning from each other it is possible to advance the two countries' knowledge of seas and shared ocean enabling more effective protection and sustainable management of the global ocean (European Commission 2018).

8. The "*Ocean Data Stewardship in the UN Decade of Ocean Science for Sustainable Development" Training Course*

As the world approaches the UN "Ocean Decade", the need for data is stronger than ever before. Data stewardship and the right data and information technology or tools can be incredibly powerful in the design and realization of the sustainable goals. To this regards, the "Ocean Data Stewardship in the UN Decade of Ocean Science for Sustainable Development" Training Course was

jointly organized by the IOC-UNESCO, the Ocean Teacher Global Academy (OTGA)[13] and its Regional Training Center in Tianjin, China (RTC China) (IOC-UNESCO Database 2021).[14] The training course took place from 7 to 25 June 2021 and was sponsored by the China's National Center of Ocean Standards and Metrology China (NCOSM) – which hosts the OTGA's RTC China – and NMDIS. It highlighted the importance of ocean data stewardship in the Decade of ocean science, introduced the cutting-edge ocean data management strategies, methods and tools, and shared experience in ocean data and information technology development and application in China. The audience targeted in ocean data and information managers, ocean data analyst, ocean information technology researchers, and researchers engaged in integrated ocean management was encouraged to share policies and practices and technology of ocean data stewardship and data service in their countries and contribute their wisdoms to ocean data management and sharing in the future.

Sharing the latest development of ocean data stewardship methods and tools, introducing scenarios where ocean data and information technology are used to support sustainable development, and inspiring discussion on the role of ocean data in realizing the sustainable development goals for the 'ocean we want' were set as the aims and objectives of the training course. While developing knowledge of the status and trends of international ocean data management, better understanding of the status and importance of ocean data in the context of the UN "Ocean Decade" and improving skills of integrated ocean data management and ocean information R&D as the learning outcomes (IOC-UNESCO Database 2021).

9. China's Blue Financing: the first "Blue Finance" pilot brand

Few places in the world have greater need for a new type of sustainable debt to fund water projects and protect the oceans than Asia, with its more than 100,000 km of coastline (Bloomberg for SCMP 2021a). Chinese financial institutions are increasingly keen to issue blue bonds[15] in support of

[13] The OTGA builds upon and expands the existing Ocean Teacher Academy based at the IOC-UNESCO Project Office for the International Oceanographic Data and Information Exchange programme (IODE) in Oostende, Belgium, to a truly worldwide training facility. It provides a programme of training courses that cover a range of topics related to the IOC-UNESCO programmes, contributing to the IOC-UNESCO Mandate and the implementation of the IOC-UNESCO Capacity Development Strategy, enabling equitable participation of all IOC-UNESCO Member States and IOC-UNECSCO Programmes, ultimately contributing to the sustainable management of oceans and coastal areas worldwide, and relevant to Member States in the regions. The OTGA has established a global network of Regional and Specialised Training Centres (RTCs & STCs) to deliver customised training for ocean experts and professionals to increase national and regional capacity in coastal and marine sciences, services and management. The programme "International Oceanographic Data and Information Exchange" (IODE) of the IOC-UNESCO was established in 1961. Its purpose is to enhance marine research, exploitation and development, by facilitating the exchange of oceanographic data and information between participating Member States, and by meeting the needs of users for data and information products. See for both references: https://classroom.oceanteacher.org; https://www.iode.org.

[14] See reference for the programme of the course: http://legacy.ioc-unesco.org/index.php?option=com_oe&task=viewEventDocs&eventID=3040.

[15] Green bonds are issued by governments or companies to raise finance for an environmentally friendly project. These bonds are then traded on the financial markets. Blue bonds operate in the same way and are issued in order to finance ocean-related projects.

the sustainable ocean economy but a system of standards needs to be drawn up first. For some years now, China – the world's biggest emitter of carbon dioxide and largest plastic producer (European Commission 2021b) – has been working on a green finance system to fund the construction of its "ecological civilization" and industrial restructuring. According to data provider Refinitiv, the country has been one of the world's largest green bond markets and overtook the US in leading global surge in green bond financing as of May this year, accounting for 13.4% (US$ 26.1 billion) of all green bond proceeds globally – global issuances growing threefold to about US$ 194 billion in the first five months of 2021, the fastest pace in five years (SCMP 2021b; Reuters 2021).

Blue bonds, designed to support sustainable development of the ocean economy, are building on that success. But there are differences that need to be taken into account. Over the past 12 months, Chinese institutions have been arriving on the blue finance scene. Last September, the Bank of China's Paris and Macau branches issued, respectively, US$ 500 million (3.2 billion yuan) in three-year blue bonds and US$ 442.5 million (3 billion yuan) in two-year blue bonds. These proceeds will fund current and future ocean-related projects in China, the UK and France, such as wastewater treatment plants, treating effluents before they are discharged into the sea, and offshore wind power. Two months later, Industrial Bank's Hong Kong branch sold a similar US$ 450 million bond (Bloomberg for SCMP 2021a). In November 2020, the Qingdao Water Group issued 300 million yuan (US$ 46.4 million) of blue bond debt. Chinese institutions have now issued more blue bonds than institutions from any other market (Xu 2021). The country is seeing strong growth in offshore wind, marine tourism, shipbuilding, ocean chemicals and biomedicine. Those fields will require financing, and that provides the basis for a market in blue bonds. China's regulators are also involved. As reported by Nan (2021), the China Banking and Insurance Regulatory Commission has described blue bonds as an "innovative policy tool".

On the same day of the Ocean Decade Workshop held in Qingdao, China, the World Bank Group International Finance Corporation (IFC), experts of the FIO, and the pilot Bank of Qingdao respectively provided technical guidance, consultation, and promoted the first domestic "Blue Finance" project, officially releasing the "Blue Finance" brand (FIO-MNR 2021c). The event is a supporting one for the 2021 World Ocean Day and National Ocean Day. Leaders from relevant departments of Qingdao City, experts from IFC and FIO, and other units attended the conference. While international institutions such as the UN Environment Programme, the Asian Development Bank, and the Italian bank Intesa Sanpaolo joined the online conference.

According to the current internationally recognized definition, the core of the Blue Economy is on the marine ecological protection and sustainable marine economic development. Supporting the sustainable development of the ocean is not only a response to the UN Sustainable Development

Goals, but also an obligatory action to protect the ocean on which we depend and rely (FIO-MNR 2021c).

As an expert representative, the director of the Coastal Zone Science and Ocean Development Strategy Research Center of Ocean One, chief expert of major projects of the National Social Science Fund, and senior economic expert of the World Bank IFC, Dr. Dahai Liu shared his understanding of blue finance. Dr. Liu Dahai pointed out that blue is a color metaphor that can quickly form an international consensus (FIO-MNR 2021c). It should be necessary to comprehensively evaluate the global ocean governance, climate change response and national ecological restoration needs in order to explore and promote the capabilities of blue finance. At the same time, attention should be paid to the six major characteristics of blue financial products: substantive, profitable, withdrawable, iterable, recyclable and promotable.

Dr. Liu Dahai also shared his academic views on promoting the sustainable and healthy development of the ocean. He suggested that the strong support provided by five forces which are the realization of the ecological products value, the global carbon emission reduction, the reform of natural resource system, the empowerment of scientific and technological innovation and the optimization of the whole global industrial chain, will ultimately enhance the optimization of the "Blue Finance" brand's capacities/promotion power, provide experience and knowledge for the further promotion the blue finance, and help the sustainable and healthy development of the ocean (FIO-MNR 2021c).

10. The pivotal role played by the decarbonization of China's shipping and maritime industry

Another pivotal role of China's contribution to the "Ocean Decade" is played by the goal of guaranteeing emission reduction from ships and the energy transition of the shipping industry. Since the decarbonization of such a critical sector for the world economy has increasingly gained momentum and has a tremendous impact in the fight against climate change, China has been putting a lot of efforts, investments and resources on it. This is significantly in line with the adoption of more forceful policies and measures towards achieving carbon neutrality by 2060, as stated in the 14th FYP. In this regard, several major players in the Chinese economic system pledged to contribute to the decarbonization of the shipping industry.

On September the 22nd, 2021, one year after Chinese government's announcement of 'Carbon Emission Peak & Carbon Neutrality', COSCO SHIPPING, together with Sinopec and China Eastern Airlines jointly held the certification ceremony of China's first voyage of full lifecycle carbon neutral oil (COSCO SHIPPING 2021a). In the ceremony, COSCO SHIPPING, as one of the three companies, was awarded with China's first carbon neutral oil certification issued by the Shanghai Environment and Energy Exchange. The project is an innovative practice of 'new green traffic model', in which

COSCO SHIPPING, Sinopec and China Eastern Airlines gave full play of their respective advantages, explored a cross-industry path with full lifecycle coverage and zero carbon emission. Sinopec took the responsibility of carbon neutrality in oil mining, storage, processing, and the consumption of motor spirit, LPG, and other petroleum products. COSCO SHIPPING was responsible for the carbon neutrality in crude oil transportation and marine fuel combustion. China Eastern Airlines was responsible for the carbon neutrality of the consuming of Jet fuel.

It is a milestone to reach the target of carbon emission peak and carbon neutrality in China's transportation and energy sectors. Crude oil of this project was the quota oil of Sinopec International Petroleum Exploration and production corporation, originated from Angola. 30,000 tons of crude oil would be refined at Sinopec Gaoqiao Petrochemical after transshipment, generating 8,963 tons of motor spirit, 2,276 tons of automobile diesel, 5,417 tons of Jet fuel, and 2,786 tons of LPG, 6,502 tons of marine diesel and 2,998 tons of low sulfur marine fuel oil. These carbon neutral gasoline and diesel will be officially provided to the market by Sinopec in specific gas stations this year (COSCO SHIPPING, 2021, a). In order to offset the carbon emission in the full lifecycle of oil, COSCO SHIPPING, Sinopec and China Eastern Airlines purchased the Chinese Certified Emission Reduction (CCER) quota to actively implement energy-saving and emission reduction strategy. They employed Shanghai Environment and Energy Exchange as the certification authority of the carbon neutrality project. China Classification Society Certification Company (CCS) was invited as the third-party verification institution, accurately measured the carbon dioxide emission in full life cycle and neutralized the same equivalent from petroleum mining, transportation, storage, refining and consumption.

'Going green' is the core concept of China's high-quality economic and social development in the new era (COSCO SHIPPING 2021a; Weng et al. 2018). Therefore, actively researching low-carbon and zero-carbon energy alternatives, are efforts that China is carrying forward to reduce carbon emissions and increase carbon removal. By offsetting carbon emission in land, sea and air areas, the project made a positive contribution to carbon neutrality in transportation field. Additionally, apart from being the first cooperation of China's petroleum industry, shipping industry and aviation industry to neutralize carbon, it is also an excellent example of mutual collaboration between carbon alliances, leading the low-carbon commercial ecology transformation and business ecology co-establishment, and ultimately representing the firm determination of the central SOEs to green and sustainable development. In the future, it is likely that in SOEs will continue to create value together with partners from other sectors, adhere to sustainable development, and jointly protect the blue sky and the blue sea.

Furthermore, in order to implement the strategy of becoming a maritime power and focus on the 2060 dual carbon goal, COSCO SHIPPING Heavy Industry in partnership with Dalian CRRC Diesel Engine, COSCO SHIPPING (Tianjin), China Shipping & Sinopec Suppliers Dalian Branch, Shanghai Jiao Tong University, Dalian University of Technology, China Classification Society, American Bureau of Shipping, China Development Bank Leasing and other units launched and initiated the establishment of China's first "marine clean fuel joint-study union" on October the 16th, 2021 (Yu 2021). The establishment of this union will give full play to the technical and resource advantages of each member unit, solve the common problems of the application of new green energy to ship fuel, put forward the idea of new fuel on board application and industrial chain process, and jointly promote the low-carbon development of shipping industry (Yu 2021). The "Ammonia-powered dual-fuel combustion, functional research and demonstration of supply" project was launched as the first joint scientific research project launched by the 'union'. According to Yu (2021), the project will take the 5000HP tugboat built by COSCO SHIPPING Shipyard (Dalian) as the carrier, aiming to realize the design and manufacture of ammonia diesel dual power engine, the development of key technologies and equipment such as ammonia fuel supply, storage, gas supply system, as well as the overall design and construction of the ship.

COSCO SHIPPING has been pursuing energy-saving, low-carbon green development by integrating the concepts of "innovation, coordination, green, openness and shared benefit" and sustainable development into the operation and management of the corporation and committing itself to environment-friendly operations to achieve the harmonious coexistence of economic growth and an ecological environment. It has carried out research on green ships and low-carbon alternative fuels, while leveraging its expertise to become an important player in addressing climate change (COSCO SHIPPING 2021b). The enterprises under COSCO SHIPPING have continued to prioritize environmental protection by reducing carbon emissions through technology- and management-enabled energy conservation and technological innovation. They have vigorously promoted the development of green shipping and green ports, improved energy efficiency management, and achieved remarkable results in reducing energy consumption and carbon emissions. With regards to optimizing and upgrading energy equipment to realize energy saving, emissions reduction and harmonious development, the Shanghai Huanyu Container Factory is a flagship example. To respond to the national strategy of peak emissions and carbon neutrality, improve the resource utilization ratio, improve the ecosystem and protect the environment, the subsidiary of COSCO SHIPPING Development, and the container factories under its trust management, are actively practicing the concept of "green container manufacturing", upgrading production equipment and using clean energy

to achieve energy conservation, emissions reduction and noise reduction and the healthy development of the enterprise.

Additionally, in order to minimize carbon emissions and noise pollution, they have introduced advanced equipment according to their actual needs, and increased their investment in energy saving and emissions reduction (COSCO SHIPPING 2021c). Qidong Container Factory has put into use its newly introduced pure electric fork trucks, as an important attempt to achieve energy conservation, emissions reduction, and quality and efficiency improvement. Based on the actual result of such measure, it will continue to increase the proportion of pure electric production vehicles in use in the plant (COSCO SHIPPING 2021c). Guangzhou Container Factory has introduced exhaust gas pre-treatment equipment, which helps effectively control the exhaust gas emissions to ensure that the organic exhaust gas emissions data will be far below the standard set out in environmental protection regulations. At the same time, the safety performance has been effectively enhanced, with the gas and electricity energy consumption being significantly reduced. The factory has also introduced a dust spray tower to better capture the residual dust treated by the filter cartridge, which can eliminate the hazard of environmental pollution caused by dust leakage and effectively reduce the minimum exhaust gas emission concentration (COSCO SHIPPING 2021c). Jinzhou Container Factory has introduced a new XP-B power saving control device, which adopts intelligent flexible balancing technology that can largely reduce the current supplied by the grid as well as the motor's own power loss, with obvious energy-saving and efficiency improvements.

With regards to the improvement of the proportion of clean energy to enable low-carbon intelligent efficient and safe production, Qidong Container Factory has built a photovoltaic power plant, which adopts advanced and applicable technologies to establish a “clean”, “intelligent” and “friendly” smart microgrid platform under the coordinated control of light and load. It realizes the safe unattended operation and convenient operation and maintenance, and can promote the construction and utilization of clean, low-carbon, safe and efficient modern energy system. Furthermore, the wind power station's generating units under planning and construction will make full use of the advantages of wind energy and reduce the proportion of thermal power generation and use. It will bring significant ecological and economic benefits to the green development of business after completion (COSCO SHIPPING 2021c).

According to COSCO SHIPPING (2021b), by the end of 2020, COSCO SHIPPING’s fuel consumption per ship, energy consumption per 10,000 yuan of revenue, and carbon emission intensity had decreased by 30%, 27% and 30% respectively compared with the 12th FYP period. Further, COSCO SHIPPING has developed floating state energy-saving software, through which a ship’s floating state is automatically adjusted to ensure that the ship performance consistently remains

optimal through reduced water resistance and lower fuel consumption and carbon emission. The software has been applied to 19 large container vessels of the corporation. The container liners under COSCO SHIPPING have also established an energy efficiency monitoring center to monitor the fuel consumption of ships in real time 24 hours a day, so as to realize the transformation of ship navigation from “average speed” to “average power” and reduce the instantaneous fuel consumption and carbon emission of ships (COSCO SHIPPING 2021b).

So far, COSCO SHIPPING has completed the renovation of bulbous bows on 68 vessels to reduce the water resistance of container vessels when sailing at a lower speed, and finished the retrofitting of propeller hub fins on 14 vessels to improve propeller propulsion efficiency and reduce fuel consumption and carbon emission of vessels in navigation; it has put into operation 14 special LNG carriers with dual-fuel electric propulsion, which mainly rely on natural gas evaporated from cargo tanks to serve as power fuel when sailing. These types of vessels adopt dual-fuel engine technology that can reduce CO2 emission by 20-25%. Solar energy technology has been applied on large ro-ro vessels, with 143.1 KW solar photovoltaic systems being installed to convert solar energy into electricity and provide power for ship lighting; photovoltaic power stations have also been installed on the plant roof of ship repair companies for the wide use of green energy and emission reduction (COSCO SHIPPING 2021b). With technological innovation as an instrument, COSCO SHIPPING will continue to improve its energy-saving and low-carbon management capability, continuously promote greener and more sustainable production methods, strive to reduce the carbon footprint of its container manufacturing business, fulfill its carbon emission reduction responsibilities, actively fulfill its social responsibility and make greater contributions to the development of green shipping and to the realization of the strategic goal of carbon neutrality by 2060.

Another interesting milestone is represented by the three cooperation framework agreements signed by A.P. Moller-Maersk to join hands with China Classification Society (CCS) on its decarbonization journey (Maersk 2021). As global leaders in the maritime industry, China and Denmark can be considered as natural partners both aware that maritime decarbonization can be successfully achieved only through strong international collaboration and exchange of knowledge. As a matter of fact, the agreements mainly focus on scientific and technological innovation projects, life-cycle green fuel availability and infrastructure, as well as design for carbon-neutral vessels with a strong involvement of research institutes from both sides. Like China’s objective to achieve carbon neutrality by 2060, Maersk has set a clear and ambitious goal to become carbon neutral by 2050, also by means of accelerating efforts to decarbonize marine operations (Maersk 2021). Being both globally leading maritime and shipbuilding nations, their commitment to collaborate on carbon-neutral technologies and standards and explore the opportunities for international cooperation within

sustainable and zero carbon shipping will allow for accessing a broader range of high quality resources. Open-minded discussions and trusted partnerships are paramount to develop the right set of standards, rules, and technical solutions for the benefit of the whole industry. Finally, commitments of such kind bode well towards enabling the decarbonization as a strategic imperative for the shipping industry, ultimately ensuring an effective response to the climate change challenge.

To further enabling this, the 21st edition of Marintec China will take place from December 7 to 10, 2021 in Shanghai (China Daily 2021). The biennial event will feature the latest maritime technology development trends. During the four-day event, a forum themed "Innovation, Intelligence, Low-Carbon" will be hosted, with digitalization and decarbonization as the two key topics. Austria, Denmark, Finland, Germany, Japan, South Korea, the Netherlands, Norway, Singapore, Sweden and Switzerland, are invited to set up pavilions with over 1,400 exhibitors from about 30 countries and regions expected to attend the exhibition, said Xing Wenhua, chairman of the Chinese organizing committee of Marintec China (China Daily 2021). The climate issue is closely related to all countries in the world, and achieving carbon peak and neutrality goals is an intrinsic requirement for China's high-quality development.

3.4. *Discussion on the Critical Issues for the Realization of the "Ocean Decade"*

As sees in the previous Section, the scale of the UN Ocean Decade emerges as huge but it does stand as a once-in-a-lifetime opportunity. It is probably the largest campaign in the history of natural sciences or social sciences that aims at scientifically tackling the numerous critical issues that mine oceans and seas field. The ocean regulates carbon dioxide levels in the air and water, provides oxygen, powers the water cycle, and circulates heat. It also protects coastal and marine biodiversity. While some of these services mainly benefit the ocean itself, most are important for the onshore environment and economy too. But assessing these economic contributions is still a complex task, with no well-established methods or consensus. The Blue Economy is showing strong growth, in terms of value added, investments and jobs created. But at the same time, the oceans are becoming more acidic and warmer. Sea levels are rising, currents are changing, and the ocean environment is under constant stress. These are the problems brought about by more intensive use of the oceans. If we cannot ensure sustainable development of the oceans, we will repeat the mistakes that were made on land – perhaps with even graver consequences. In its *The Ocean Economy in 2030 report* (2016), the OECD said that overfishing, ocean pollution and marine wildlife and habitat loss were due to our more intensive use of the ocean, a lack of understanding and data on the impacts we have, and a lack of integrated management (Xu 2021).

This general picture institutes the need to consider China's commitment and initiatives towards a more sustainable use of the ecological services provided by the ocean in light of a broader picture of critical issues that need to be addressed in order to have a far-reaching impact and efficiently realizing the "Ocean Decade". A fundamental question for the Decade's actions is who the main actor should be. According to the point this Chapter is trying to make, firstly, state governments should play a key role since there is the need for a strong financial support and all kinds of resources for the actions. Secondly, the UN agencies, especially the local international organizations, such as the WESTPAC, should also play a key role, because they know much about the challenges for each state in the area so they can better lead the way. And of course, the scientific community should be a major actor. Doing research, publishing is important in scientists' carriers but providing solutions is even more important. Furthermore, not much engagement has been seen in the industry so far. Indeed, the Decade is just beginning, and actors are still thinking about how to best implement it. As advocated by Martin Visbeck, Professor and Head of Research Unit, Physical Oceanography at GEOMAR Helmholtz Centre for Ocean Research Kiel, Germany, at the Fifth Xiamen Symposium on Marine Environmental Science (hereinafter referred to as XMAS-V), a special Private Sector Panel to promote the engagement of the business sector should be boosted (Zhao 2021).[16] Actually, there are quite a few private sector actors already engaged in the Decade offering, for example, consultations and services related to energy, environment, mariculture installations as well as a geographic information system (GIS) provider and instrument providers. Companies, such as Google, are also willing to offer services to the Decade (Zhao 2021). It is likely that a lot more companies will be involved in the next year when it becomes obvious to them how they can be engaged in, and benefit from, the Decade programs.

One of the reasons why not so much is heard from the industry is that the way in which the Decade is debated. Scientific forums, conferences and seminars alike are not so interesting for the private sector actors. They prefer faster-paced meetings focusing on certain business problems and models. This is something essential to vigorously consider in future discussion on how to attract their attention. The second issue to be addressed refers to the model that the Decade will propose to help build science-policy and science-industry interfaces, and encourage solution-oriented research. In developing the Decade, it is really important to make connections between groups that perhaps had

[16] On 14 January 2021, a Special Forum on the Decade was held in hybrid mode as part of the Fifth Xiamen Symposium on Marine Environmental Science (XMAS-V) in Xiamen University, China. The Forum was organized to promote the Decade through insightful talks and in-depth discussions with international and regional representatives who have been actively involved in the planning of the Decade. In addition to Dr. Ryabinin, the IOC-UNESCO Executive Secretary and Assistant Director-General of the UNESCO, Zhanhai Zhang, Chief Engineer of the Ministry of Natural Resources of China, gave an inspiring opening speech. What followed were presentations by invited speakers. They then joined a panel discussion chaired by Dr. Minhan Dai from Xiamen University.

not worked closely together in the past (Kelly et al. 2021). Actually, the structure of the Decade programs is different from traditional science programs. It requires participants that are not only scientists but also other stakeholders. Thus, the design of mechanisms to make connections between those who have been completely engaged in science, who straddle science, management and policy has to be advocated (Evans and Cvitanovic 2018). To this regard, an interesting analogy is proposed by Prof. Visbeck at XMAS-V. He argued that in the current coronavirus pandemic, we can see that in a hospital there are different types of health workers. Some take care of the patients, some analyze the viral sequence and some others work with the vaccines. Their work is different, but they work as a team. He hopes that in 2030, ocean science will be the equivalent of the hospital; that scientists, inventors, industries, policymakers and the public will work as a team (Zhao 2021). The Decade allows to think about how to learn from medical science to promote multi-stakeholder engagement. There is the need for all kinds of problem solvers to solve complicated ocean issues. There is no single category of people, scientists or engineers, that can solve the problems all by themselves. Building what could be sanctioned as a 'modern hospital of ocean science' with multiple problem solvers – scientists, engineers, technology innovators, etc. – is what the Decade is aiming to (Zhao 2021). The most dangerous thing is to put a label on an individual.

A major challenge regards the training of the future generation of scientific leaders (Kelly et al 2021). Again, it is a once-in-a-lifetime opportunity for young people. If they participate in and contribute to the programs, at the end of the Decade they will become leaders of ocean science. Although it is unrealistic and unfair to assign responsibility of the oceans solely to future generations (Pahl et al. 2017), the future belongs to them. They cannot rely on previous generations to give them the ocean they want. So, they should have a sense of responsibility and motivate themselves for action. This is a competitive world with limited resources and opportunities. Thus, our early-career ocean scientists must be proactive and self-prepared to get the opportunities. This is the beginning of their involvement (Zhao 2021). The WESTPAC has plans to help early-career scientists, including supporting them to attend regional conferences and providing them with training opportunities. From the very beginning, an early-career ocean professional network for the Decade was designed, which provides opportunities for all ocean professionals to participate in it. The Decade aims at involving as many early-career ocean professionals as possible to take the opportunity and get involved in the network (Zhao 2021). The way to motivate them to be major contributors or leaders relies on the promotion of cross-disciplinary education. Training individual students to be specialized scientists such as physical oceanographers or chemical oceanographers as the old model we have been accustomed to just does not work for the Decade. These disciplines speak different vocabularies and think in different ways. So, it is difficult for them to cooperate. In the training of the younger

generation, education should move towards training them in cross-disciplines from the very beginning. A second degree or transfer to a different major in the Master or PhD stage should be encouraged. Furthermore, encouraging them to study in different countries will provide a framework for global cooperation (Zhao 2021). Connection with the government system is also central. In Germany and the US, there are intern opportunities for Master or PhD students to spend a year or two in the political system. This way they are able to learn the language of politicians, and the politicians also like that because they need scientific information. Fostering such interns in political systems and also private sectors is crucial the Decade will also provide that kind of opportunity for young students (Zhao 2021). Therefore, adjusting the mode of current ocean science education in universities is of paramount importance and should be adopted since now (Kelly et al. 2021). The "Ocean Decade" sets a very good example of how to mobilize young scientists not only doing their own science but also thinking about real society, thinking about solutions for a better future.

Among the people living to any territory adjacent to the ocean, most of them are in very close contact with it every day, but they do not see things beyond its blue color. They do not see it as the source of energy or the key to combating climate change. Coping with this behavior is an urgent and fundamental task that requires the improvement of the ocean literacy of the public. Building ocean literacy amongst communities or groups of individuals is an approach to encourage responsible public behaviour towards the ocean and its resources (Fielding et al. 2019). Most of humans enjoy stories. Starting to tell them interesting stories about the ocean represents an approach rather practically easy to realize. Talking about how ocean scientists actually work on ships and research vessels or, the other way around, raising awareness on how ocean science works towards the preservation of mesmerizing and healthy blue landscapes when people want to take wedding photos or take trips to enjoy sunny days on the southern coast during winter times – Chinese people are an example – are all good points to develop and tell stories about ocean pollution and ocean science. This would work also for the inland public who could seem less prone to ocean literacy due to an apparently lesser exposure to ocean-related issues (Zhao 2021). However, the ocean is a great contributor to the prosperity of inland areas. For example, today we can see seafood restaurants in most cities throughout the world, where you can enjoy fresh seafood from different parts of the world. Without a healthy and clean ocean, we will not be able to enjoy that. Moreover, a safe ocean is essential for global trading, without which the inland citizens may not be able to buy clothes, toys, cellphones or cars made on the other side of the world. Also, refusing to buy products made of shark fins or other prohibited acts constitute helpful behaviors for a sustainable ocean. Engaging inland friends and families disseminating such literacy will enable the wider public to understand and care about the ocean. Another powerful way to tell stories is through television and movies. For instance, the BBC

films about biodiversity and the ocean got enormous attention in the English-speaking world. When they are translated to German, Chinese or other languages, they will also be powerful stories for the public (Kelly et al. 2021). Moreover, games and social media are also influential today. Working with those communities, for instance, working with the media stars, to tell stories about the ocean constitutes a powerful tool to reach out to much more people. Movies too can present the ocean in such a way that even those who were not knowledgeable of the ocean can understand and enjoy it. Of course, this is not a job for just scientists. Engaging society and communities in ocean dialogue can lead to the collective production of new knowledge and the exchange of non-scientific knowledge, including local, traditional and Indigenous knowledge (Thornton and Maciejewski Scheer 2012). Yet, the governments and the NGOs should get involved to provide resources and take action (Zhao 2021).

Another criticality relates to the role of governments and citizens in small islands and developing states. In the South Pacific and Western Central Pacific areas, the governments of small islands and developing states are organized by the Pacific Community, which is an organization that conducts science on behalf of those countries. The Pacific Community will form a Center for Ocean Science in the Pacific, which will be the major force to bring together these Pacific islands for the Decade (Zhao 2021). In Western Central Pacific, a lot of marine resources are actually managed by local community groups. These community groups are actively engaged in the Decade. Actually, a lot of the Decade initiatives concerning ocean reserves and ocean management were from the communities, rather than the governments. The governments are interconnectors (Vromen and Colin 2010; Gal 2017), but the communities are the real driving forces. Thus, small islands and developing countries are very active in the Decade. Their voices are well heard not only at the IOC-UNESCO level but also at the UN level. Other communities and countries are also starting to recognize the importance of small islands and some companies are willing to offer services for these pacific islands. Moreover, early-career ocean professionals from these areas are actively engaged in the Decade. They are setting a good example for global young ocean professionals.

As far as blue financing is concerning, the success of blue bonds in promoting sustainable ocean economy development requires urgent clarification and improvement of the standards to be applied. Blue bonds have always been closely associated with green bonds and are sometimes regarded as one of their subsets. The rapid growth of the green bond market and rising investor recognition has laid a good foundation for the new arrival. The blue bonds from the Qingdao Water Group and the Bank of China were issued in line with norms for green bonds. However, the blue bonds being prepared by the Bank of Qingdao, with assistance from the World Bank's International Finance Corporation (IFC), are somewhat different. The issuer will work to a list of blue bond

projects suggested by the IFC to filter and decide on recipients of investment, rather than simply looking for ocean-related projects in lists of approved green bond projects. Key criteria will be how sustainable the economic activity is, and the degree of the project's impact on the ocean environment (Xu 2021). While those bonds have not yet been issued, their preparation has become a highlight of innovation in the Chinese sustainable finance sector this year. Whether these ocean-specific bonds should have their own sets of standards is a critical question to answer by looking at how the impacts of marine economic activities from the blue economy and the onshore economy differ across time and space. An interesting analysis is offered by Nan highlighting that (2021): 1) the natural processes of the ocean, its ecosystems and flora and fauna do not respect national boundaries; 2) the structuring of economic rights at sea is different, making regulating economic activity harder; 3) the externalities of the blue economy – the consequences of industrial and commercial sea-related activities – need to be managed differently; 4) the sustainable development of the ocean will require more integrated planning also reflecting the value of ecological services provided by the ocean. These are all criticalities that need to be taken into account. So alongside a system of standards for sustainable blue finance, to allow for more accurate and comprehensive definitions of sustainability for the blue economy, we also need to look at ocean-related environmental, social and governance risks for all sectors. Onshore industries responsible for plastic pollution of the ocean are a case in point. Standards for blue bonds, and the establishment of a blue finance system, taking into account the nature of the externalities of the blue economy, is not just needed. It is increasingly urgent (Xu 2021).

With specific regard to China and the "Ocean Decade", over the past 40 years, the Chinese economy has been growing rapidly, especially in the coastal areas. Nevertheless, this has been accompanied by problems of marine pollution and unhealthy marine ecosystems. In fact, although it is extremely impressive to witness about the country's proactive engagement in the Decade with reference to the abovementioned commitment and initiatives, several challenges still remain for China to be addressed.

First, as regards ocean science, challenges include insufficient observation and monitoring ability, inadequate understanding of global change and human impacts on the global ocean, and the science-based governance that China is not well equipped with. Moreover, with reference to the improvement in ARC with time shown by China in the national positional analysis in ocean science by category mentioned in paragraph 3.3.3, changes in regional or national journals that include translations to English could be improving the impact of Chinese ocean science research. Second, under Chinese culture and environment, how to get broad society engaged is also an issue to deal with. The science community of China, including the young students, is actively engaged in the Decade. But that is not enough. There is the need to attract the attention and promote the engagement

of the public and different stakeholders. For this, China can take advantage of the visibility of the Decade to really reach out to society. To this regard, Jolly et al. argue that civil society and non-governmental organizations (NGOs) form another group that can play a multitude of roles in the Ocean Decade, ranging from funding and generation of science to advocacy with national governments and policymakers, and education and outreach with local communities (IOC-UNESCO 2021c). Benefits to NGOs and civil society from engagement in the Ocean Decade are also wide and varied, ranging from increased access to resources and innovative partnerships, and improved access to data and information for use in their activities (IOC-UNESCO 2021c). However, for China, and many other countries, the language barrier is a great challenge. Since the working language of most international programs is English or French, it is difficult for Chinese people, especially the broad public, to get informed and engaged. Considering the large world populations that do not take English as their mother tongue, the language barrier is a great challenge for the future of ocean science. Finally, the biggest challenge is to attract more attention and support from the government. All the Decade actions need financial, policy and organizational support from the government. It is the key to success. More communication between ocean scientists and different government agencies, including the MNR and the MOST should be encouraged. Third, how China can maximize its action in cooperating with other countries and training young scientists from other parts of the world constitute another challenge that need to be addressed. To cope with this, the technological advancements and innovation capacity which constitute the neuralgic center of the successful economic model, represent attractive forces for China to leverage on in order to actively engage and propose actions for cooperation with other countries and for forging future ocean scientists.

The Decade provides China with a great opportunity to address these challenges. In addition to a series of strategies and policies that are consistent with the UN Ocean Decade and the declared willingness to actively take part in the Decade as discussed in Section 3.3, the Chinese government will establish a National Committee for the Decade and coordinate all marine scientists and stakeholders to draft the National Action Plan for the Decade, as announced by Mr. Qiao Fangli at XMAS-V (Zhao 2021). Furthermore, many possible plans and actions for the Decade are emerging. A Chinese proposal will be submitted, including the planning to host an international Ocean Summit on the Decade in 2022. China would also like to share its satellite technology and data with the global community to enhance the joint observation of the global ocean ant share its knowledge and innovative theories to improve the prediction ability of the global ocean, typhoon and climate. It will also work with the WESTPAC to encourage the younger generation of ocean professionals from China, Asia and the globe (Zhao 2021).

The UN Decade is not just about ocean science, but also about the transformation of knowledge to solutions and actions to protect the ocean. So, it is time to take actions and actions are needed from all member states including China.

3.5 *Conclusions*

The ocean is the planet's largest ecosystem. It stabilizes climate, stores carbon, nurtures unimaginable biodiversity, and directly supports human well-being through food and energy resources, as well as by providing cultural and recreational services. Unfortunately, despite improved management and conservation actions, much of the ocean is now seriously degraded. As the world population will reach an estimated 9 billion people by 2050, impacts on the ocean associated with human activities will increase. This underscores the need for humanity to address and change its own actions and behavior. Action can only be effective if it is based on sound knowledge informed by science. There is an increasing need to find scientific solutions that allow us to understand the changes taking place in the oceans, and to reverse its declining health. Ocean science has made great progress over the last century in exploring, describing, understanding and enhancing our ability to predict changes in the ocean system. On the policy level, there is a tremendous opportunity in the coming decade to harness interdisciplinary advances in ocean science to achieve a better understanding of the ocean system. This will enable the delivery of timely information about the state of the ocean, and will allow us to define interconnected scenarios and pathways for sustainable development. Ocean science can help us to address impacts from climate change, marine pollution, ocean acidification, the loss of marine species and degradation of marine and coastal environments.

Against this backdrop, the scale of the UN Ocean Decade's is huge but it does stand as a once-in-a-lifetime opportunity. It is probably the largest campaign in the history of natural sciences or social sciences. By 2030, IOC-UNESCO endeavors to have made possible significant progress towards: identifying and removing sources of ocean pollution; mapping and protecting marine ecosystems; ensuring the ocean is harvested in a sustainable way; protecting people from ocean hazards; building capacity to understand and predict ocean conditions; opening up access to ocean data and technologies. As for policy implications, much of this will be made possible by investment in open sources of data, information and technology. On the other hand, the ambition of the Ocean Decade will be achieved by the mobilization of actors around the world and the engagement of many different stakeholders to create new ideas, solutions, partnerships and applications, these include: scientists, governments, academics, policy makers, business, industry and civil society. A fundamental question policy making needs to address is how to help build science-policy and science-industry interfaces, and encourage solution-oriented research. In developing the Decade, it is really

important to make connections between groups that perhaps had not worked closely together in the past. Building what could be sanctioned as a 'modern hospital of ocean science' with multiple problem solvers – scientists, engineers, technology innovators, etc. – is what the Decade is aiming at to promote multi-stakeholder engagement.

Focusing on China, President Xi Jinping has, on various occasions, called for strengthening cooperation in protecting the oceans, and has made great efforts to push forward ecological civilization construction and practice the concept of "maritime community with a shared future", which has gained worldwide resonance. Moreover, the Chinese government actively promoted exchanges and cooperation with other coastal countries, establishing a new model of international cooperation in MSP in the recent years. At present, ocean-based cooperation in market, technology, information, culture, and other areas is steadily deepening. The reason for China to propose jointly building the 21st Century Maritime Silk Road is to facilitate maritime connectivity, pragmatic cooperation in various fields, and the development of the BE, as well as to promote the integration of maritime cultures and to improve maritime wellbeing. As a matter of fact, the 14th FYP highlights China's willingness to a more proactive engagement with regards to a "in-depth participation in global ocean governance", prompting the establishment of a "fair and reasonable international ocean regime" and the development of "blue partnerships" as well as the construction of an "ocean community with a shared future for mankind." The selected excerpts of the 14th FYP are consistent with a broader agenda that Chinese policymakers have set when it comes to the marine domain. Protecting the marine environment has been an integral part of this grand strategy and it has materialized in the "14th FYP for National Marine Ecological and Environmental Protection", which is the first FYP in the field of marine ecological environment protection after institutional reforms, and it is a key document to guide marine ecological environment protection in the coming period.

Although it is extremely impressive to witness about the country's proactive engagement in the Decade with reference to the policy, strategies and initiatives analyzed in this Chapter, several challenges still remain for China to be addressed. First, as regards ocean science, challenges include insufficient observation and monitoring ability, inadequate understanding of global change and human impacts on the global ocean, and the science-based governance that China is not well equipped with. Second, under Chinese culture and environment, how to get broad society engaged is also an issue to deal with. The science community of China, including the young students, is actively engaged in the Decade. But that is not enough. There is the need to attract the attention and promote the engagement of the public and different stakeholders. Third, how China can maximize its action in cooperating with other countries and training young scientists from other parts of the world constitute another challenge that need to be addressed. The latter, in particular, opens up opportunities for EU-

China cooperation. EMOD-PACE, which can be considered as the starting point of a new phase of strategic EU-China ocean relations, highlights the belief that by working together and learning from each other it is possible to advance the two countries' knowledge of seas and shared ocean enabling more effective protection and sustainable management of the global ocean. Furthermore, in line with the adoption of more forceful policies and measures towards achieving carbon neutrality by 2060, as stated in the 14th FYP, 'going green' is the core concept of China's high-quality economic and social development in the new era. Therefore, actively researching low-carbon and zero-carbon energy alternatives, are efforts that China is carrying forward to reduce carbon emissions and increase carbon removal. Commitments of such kind bode well for European companies to leverage on their expertise and know-how for enabling the decarbonization as a strategic imperative for the Chinese shipping industry for instance, ultimately ensuring an effective response to the climate change challenge. The climate issue is closely related to all countries in the world, and achieving carbon peak and neutrality goals is an intrinsic requirement for China's high-quality development that ultimately opens up opportunities of strategic relevance for European companies.

3.6 *References*

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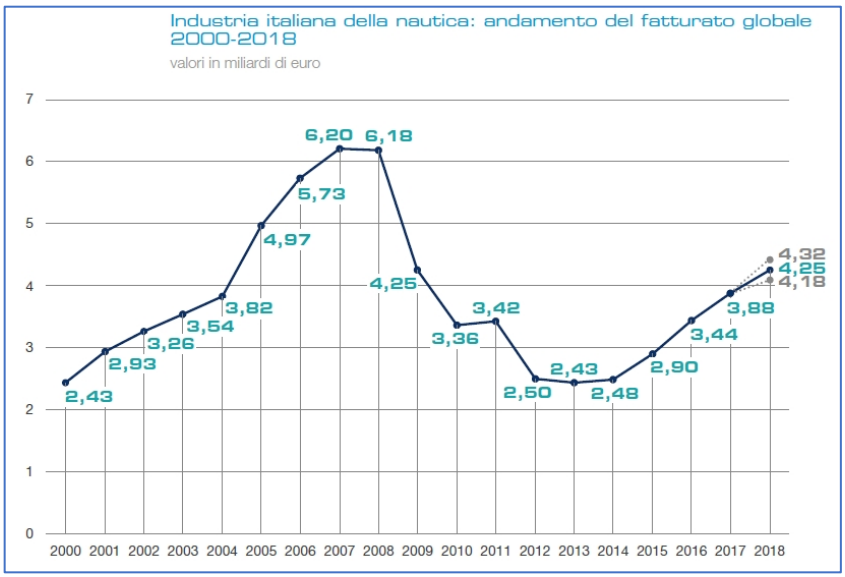
Chapter IV

The Shipbuilding Industry in the Marche Region: Prospects and Optimization of the Supply Chain

4.1 *Introduction*

The Italian shipbuilding sector is experiencing a period of excellent "competitive health". At the end of 2018, sales had improved by over 9% with respect to the previous years, and the industry had recovered well from a long period of deep decline begun in 2008, which reached its low point in 2013 when sales reached barely 2.4 billion euro, compared with 4.3 in 2018 (UCINA 2019).

Figure 1: Italian nautical sector industry: global sales 2000-2018.



Source: UCINA Confindustria Nautica, "La nautica in cifre. Monitor 2019", 2019.

The shipbuilding industry in the Marche Region, in Italy, is a particularly interesting case study. Regional enterprises are particularly specialized in activities of maintenance and refitting. The port area of Ancona, in particular, is one of the leading sites for what is considered the "prince" of shipbuilding, the construction and maintenance of superyachts. This segment is particularly important as it has been able to attract the best talents and skills to a sector that provides an extraordinary showcase for regional excellence (Battaglia 2019). As a matter of facts, Italy ranks at the top for orders of nautical craft in excess of 75 feet (Sole24Ore 2019). In 2018, the 379 units under production in Italy out of the total of 830 worldwide, which corresponds to 45.7% of the total, confirms it (Battaglia 2019).

The positive performance of the sector, particularly in superyacht construction, in the overall regional industrial system, suggested more in-depth exploration of the sector to understand to what

extent it already is, and could be even more, an actual locomotive for the system of highly qualified, often technologically advanced artisanal subcontracting that the industrial ecosystem of the region is already able to provide.

4.2 *Methodology*

In writing this contribution, which was carried out together with colleagues from ISTAO on behalf of Fondazione Marche, I had ample recourse to the latest studies on the shipbuilding industry and carried out a survey investigating the sector in depth. Semi-structured interviews with top management of the most representative regional shipyards and a sample of subcontractors and companies were conducted to witness the growth of the industry and provide useful insights.

4.2 *The Reference Scenario*

The future of the BE is highly promising indeed. With investments in innovation and thoughtful, responsible management, integrating environmental, economic and social aspects, it would be possible to double the value of the sector sustainably by 2030, the EU declares (2018).

Figure 2: EU share in the global Blue Economy.

According to this report by the Organisation for Economic Cooperation and Development (OECD) (2016), Europe accounts for 11.6 % of the global ocean economy, as follows, for 2010[15].

Sector	VA (EUR billion)	% of World GVA	Employment (thousand jobs)
Shipbuilding & repair	14.0	25	400
Sea and Coastal transport			
Marine equipment	20.16	12	
Port activities	44.39	23	
Marine and coastal tourism	136.5	35	
Industrial capture fisheries	5.0		
Industrial marine aquaculture	0.85	9	100
Fish processing	11.06	14	
Offshore oil and gas	140.0	27.7	342
Offshore wind energy	2.61	90	

*some of these values may differ from the estimates provided in this report due to different coverage methodology and years of reference.

Source: The 2018 Annual Economic Report on EU Blue Economy, European Commission, 2018.

Freeing the potential of the BE in the Marche regions also means ensuring growth in many other sectors. In addition to fishing, the BE means aquaculture, coastal tourism, shipbuilding, shipping of goods and passenger, energy from the sea as well as the emerging new blue biotechnologies. In particular, the shipbuilding sector occupies a strategic role in the March region, where it consists of over 300 enterprises, including several world-renowned excellences of "Made in Italy" fame; it is a sector that in 2018 exported production for a value of about 55 million euro (Battaglia 2019). With 215 km of coast, it is an immense virtual harbour that runs from Pesaro to

Ortona, and a series of outstanding ports like Ancona-Falconara Marittima, San Benedetto del Tronto and Pescara, the Port Authority for the central Adriatic is part of a system covering the Adriatic as well as the Ionian portion of the Mediterranean that, in 2018, reported an increase in passengers as well as a strong position in the shipment of goods (Battaglia 2019). The port of Ancona, where the traffic of merchandise remained steady at about 11 million tons, is a leading contributor to movement on the highways along the Adriatic Sea, which reported 4,770,465 tons of goods, up +2% over 2017, and 1,151,266 passengers (+6%). Forty cruises visited Ancona in 2018, with over 67,000 passengers (+29%), and 46 are scheduled to stop there in 2019: that sector is growing thanks to the strong relationship with the MSC cruise line, and the increasing confidence shown to other important companies in the sector (Battaglia 2019).

Among the future plans of the area are a multipurpose port whose main productive functions will be fishing, quality shipbuilding, traffic of goods and passengers, logistics, tourism and harbour services. Increasing the capacity of the Fincantieri shipyard and construction of a new cruise ship docking area Both are fundamental to the overall project of transformation that involves the entire port and has already provided for demolition of the silos at the Marche wharves.[1]

4.3 *Analysis of The Nautical and Shipbuilding Industry*

4.3.1 *A Global Picture*

Italy excels in the shipbuilding sector and leads the field worldwide; both as regards the construction of cruise ships and in that of large yachts over 75 feet (Sole24ore 2019). Other types of ships in the cargo sector such as container ships, bulk carriers, oil and gas tankers, which have more standardized design, are by now almost entirely built in Asian countries, in view of the low cost of labour, particularly in countries like China, Korea and Japan (Sole24ore 2019). If we are going to present a complete picture of the sector, however, we would be better rely on some original data. In 2018 the demand for merchant shipping in the world reached a compensated gross tonnage of 28.4, an increase of +32% over 2017 (Fincantieri Data). That year, there were already signs of recovery on the market after a period in which demand had slumped, largely due to excess cargo bay capacity which had developed in the previous years.

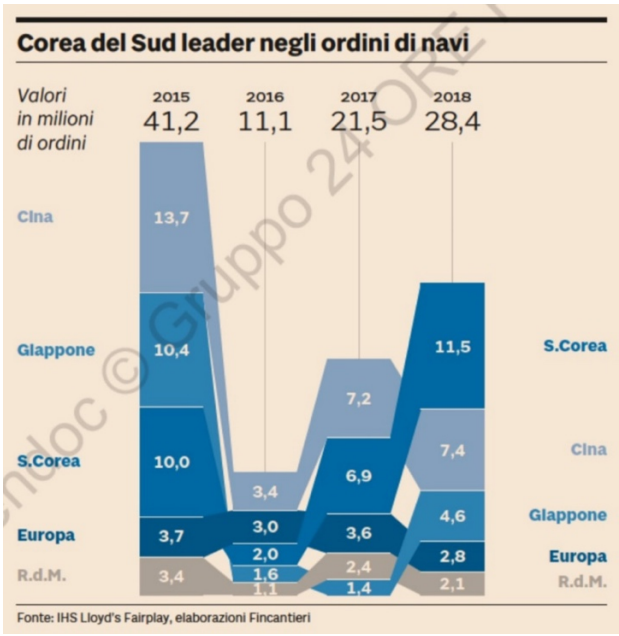
In this context, the Asian countries, China in particular, played a decisive role. The political strategy in which the Chinese government has been engaged in the past 10-12 years focuses on making that country the number one industrial power in the world and includes shipbuilding as one of the primary sectors (Sole24ore 2019). Beijing has poured massive government aid into the sector

[1] A decision born from the change in the grain market, which will allow new space to be available for port activities.

in the last ten years (Ferrari 2012). This has enabled thousands of shipyards to open in China, with a formidable production capacity, later fed through the offer on the market of ships at rock bottom prices, only sustainable thanks to government aid. China continues to flood the market with new units, leveraging not only the price but also the offering of extremely favourable financing terms to shipping magnates, also with the support of government aid (Sole24ore 2019). South Korea, for its part, though estimating its ability to absorb worldwide demand in the longer term, has also invested heavily, with government aid, in shipyards capable of producing large numbers of assembly-line ships, engaging in a competitive price war with Japan. These dynamics have virtually excluded the European shipyards from the market, by catering to shipping companies willing to accept mass produced vessels (Sole24ore 2019).

Eventually, however, the situation has led to an overcapacity of production and the reduction of the purchase prices of new cargo ships, which induced shipping companies to lower their freight rates in order to reduce their amortization rates to lower levels than ever in the past (Sole24ore 2019). This had the effect, however, of creating an excess of cargo bay capacity brought freight rates even lower, under pressure from the Chinese shipping companies which had adopted a policy of rate reductions supported by government subsidies. In 2016, orders for new ships fell by 73%, the worst with respect to the 20 previous years. In 2017 a recovery began, though not in all segments.

Figure 3: Orders of ships in the world (2015-2018).



Source: Il Sole 24 Ore from IHS Lloyd's Fairplay, Fincantieri Group elaboration, 2019.

The scenario is completely different regarding cruise ships, which require the highest technology and continue to be built almost exclusively in Europe. The leading shipyards were Fincantieri (Italy), Meyer Werft (Germany) and Stx (France). Thanks to its advantage in this sector and, to a lesser extent, in the construction of ferries, in 2018, European shipyards were able to cover

10% of the demand worldwide, compared with 41% by Korea, 26% by China, 16% by Japan and 7% by the rest of the world (Sole24Ore 2019). The cruise ship segment, in particular, did exceptionally well last year. Among units with gross tonnage in excess of 10,000 tons orders were placed around the world in 2018 for 23 ships, the same number as in 2017 (data from Fincantieri). In addition, memorandums of understanding, agreements and letters of intent were signed for another 17 vessels. This means that as of December 31, 2018, the order portfolio consisted of 103 ships, with deliveries until 2027, equivalent to 45% of the current offering of the cruise fleet. The cruise sector, with a gross tonnage of about 2.3 million, accounts for approximately 8% of the global total of orders (UCINA 2019).

In the ferry sector as well, in 2019, 27 orders were place for vessels exceeding 500 ft. in length, confirming the recovery of demand. In 2017 the order portfolio for ferries longer than 500 ft was 17 units. In the past, the increase in the volume of passengers in key markets was slow, while in recent years, the lack of investment in the construction of new vessels has limited the number of orders, but demand for new ships in resuming again, possibly also because future regulations will force the older vessels off the market by 2020. In the medium and long term, an increase in the demand for new vessels is expected, also due to obsolescence of the fleet currently in service (UCINA 2019).

Finally, the market for military vessels, finally, has shown considerable dynamism. In 2018, orders were place for 167 units for a value of about 51.2 billion euro, 40% of which (or 61 units) are for export.

- ***Trends***

1. *Geography of the sector*

In recent years, the geography of the shipyards has undergone a number of changes. Italy's financial newspaper, Il Sole 24 Ore (2019), reports in a special section devoted to the economy of the sea, as part of its series "The Economy around Us", that the Italian shipbuilding giant, Fincantieri, has signed an agreement to collaborate with Genova Industrie Navali (Gin), a holding company incorporating two historic private shipyards: T. Mariotti and San Giorgio del Porto. The agreement will cover a range of areas, from new construction to repairs and conversions, as well as outfitting and equipping the vessels. The agreement stipulates that Fincantieri will acquire a minority share in the holding company of the group, and an option, also for a minority share, in Mariotti. The group, with Italian public capital, is gearing up, among other things, to compete in China. It has reached an understanding with the China State Shipbuilding Corporation (CSSC), the largest Chinese shipbuilding conglomerate. The understanding includes a joint venture to build the first cruise ships ever produced in China for the local markets, and other related activities, but could spread, thanks to an ad hoc agreement, to include research projects and development in other areas of nautical

mechanics such as the oil & gas sector, cruise ships and ferries, mega-yachts, special ships, infrastructures in steel, systems, engineering, interiors and the creation of a supply chain in the cruise sector.

2. *Gigantism*

In the last several years, for certain categories of ships, in particular container ships and cruise ships, the shipping companies have embraced the strategy of gigantism, ordering larger and larger vessels It is a strategy that favours economies of scale but that has not failed to generate a series of problems (Sole24Ore 2019). The increase in size of the ships responds to the need increasingly felt by global maritime carriers to lower their operating costs. This means, however, that the ports must make costly investments in new structures which, especially in Italy, can require considerable amounts of time to build (dredging, building wharves capable of withstanding the arrival of enormous vessels, new docking facilities capable of reaching the most distant rows of containers, customs warehouses for unloading the huge quantities of goods that arrive in a single voyage, but also maritime stations capable of processing thousands of passengers) (Sole24Ore 2019).

As regards container ships, the rush toward gigantism, with the construction of barge-like vessels capable of transporting from 21,000 to 23,000 20-ft. containers in a single voyage, this was the result of the concentration of most of the traffic in the holds of a few large shipping groups that had monopolized the market (Sole24Ore 2019). While twenty or so years ago, the top 20 container shipping companies controlled 80% of the market, the same percentage is now controlled by the top four in the world, the Danish company Maersk, the Italian-Swiss company MSC, the French company Cma-Cgm and the Chinese company Cisco (Sole24Ore 2019). Very few players are thus imposing a naval policy of gigantism that is conditioning more and more the traffic and infrastructures receiving them. The load volumes carried by the mega-vessels, on the other hand, require radical changes to the organization and operation of the ports to prevent possible effects of congestion in the transfer of goods to the centres closest to the markets. It thus becomes necessary to build infrastructures of connection between the ports and inland regions, without creating bottlenecks. Gigantism is also a problem from the standpoint of the organization of labour in the ports (Sole24Ore 2019). While previously ports had a steady flow of goods with smaller ships, the mega-ships impose different rhythms, with peaks of activity concentrated in shorter periods, alternating with longer periods of empty wharves. It is a situation of difficulty about which numerous Italian and European port associations have complained.

4.3.2 *A Focus on the Regional Framework*

- *Enterprises*

Data confirmed up to the end of 2018 on the companies operating in the nautical sector of production and services, compared with data from the end of 2009, reveal how the sector has evolved strenuously, also from the standpoint of the business structure, in the direction of service activities (Battaglia 2019). The companies in the nautical sector of service (repairs and maintenance, wholesale trading of craft, retail sale of boats and accessories, rental of pleasure craft without crew) increased by 39 units between 2009 and 2018, while the number of companies engaged in production decreased by 21. Among these latter, however, it is important to note the significant increase in the number of companies producing craft for pleasure and sports (+23 units, an increase of 20.7%) (Battaglia 2019).

This means that there has been a growth in the number of businesses engaged in production in the most representative segment of shipbuilding in the Marche Region (that of luxury yachts), and in the services more directly linked to the sector (that of repair and maintenance of ships and pleasure vessels in general).

If we consider that the period was one in which the global economic system was experiencing a profound crisis, as well as a crisis specific to nautical production in the Marche region, we can see that the sector gave evidence of extraordinary resilience focusing, in a more modern and determined way, on service, while maintaining the fabric of its most highly qualified production companies.

- *Distribution throughout the Region*

The geographic outlines of the situation point to a number of interesting considerations. With reference to the product categories for which we have detailed classification, it is interesting to note how the two most active provincial districts in terms of shipyards, Pesaro-Urbino and Ancona, are both reporting a decrease in the number of companies, while also remaining sharply divided as to product characterization: the province of Ancona for the construction of ships, that of Pesaro and Urbino for pleasure craft.

Table 1: MARCHE - companies active in the main nautical activities (production and services)

2009 *province*	AN	AP	FM	MC	PU	Totale
TOTALE COSTRUZIONE NAVI E IMBARCAZIONI *	85	19	7	18	168	297
di cui: Costruzione di navi e di strutture galleggianti	*22*	*11*	*3*	*11*	*33*	*80*
Costruzione di imbarcazioni da diporto e sportive	*18*	*7*	*7*	*10*	*69*	*111*
ripar. manutenz. navi comm. e imbarcazioni diporto **	16	6	2	6	42	72
commercio all'ingrosso imbarcazioni	1					1
commercio al dettaglio natanti e accessori	7	1	1		6	15
noleggio senza equipaggio imbarcazioni da diporto	6	1	2	4	11	24
totale servizi considerati	30	8	5	10	59	112

2018	AN	AP	FM	MC	PU	Totale

TOTALE COSTRUZIONE NAVI E IMBARCAZIONI *	73	14	4	16	169	276
di cui: Costruzione di navi e di strutture galleggianti	*35*	*8*	*2*	*9*	*31*	*85*
Costruzione di imbarcazioni da diporto e sportive	*18*	*5*	*2*	*6*	*103*	*134*
ripar. manutenz. navi comm. e imbarcazioni diporto **	40	4	1	14	52	111
commercio all'ingrosso imbarcazioni	2	1				3
commercio al dettaglio natanti e accessori	9	2	1		6	18
noleggio senza equipaggio imbarcazioni da diporto	5	2	3	3	6	19
totale servizi considerati	56	9	5	17	64	151

var.ass. 2009-2018	AN	AP	FM	MC	PU	Totale
TOTALE COSTRUZIONE NAVI E IMBARCAZIONI *	-12	-5	-3	-2	1	-21
di cui: Costruzione di navi e di strutture galleggianti	*13*	*-3*	*-1*	*-2*	*-2*	*5*
Costruzione di imbarcazioni da diporto e sportive	*0*	*-2*	*-5*	*-4*	*34*	*23*
ripar. manutenz. navi comm. e imbarcazioni diporto **	24	-2	-1	8	10	39
commercio all'ingrosso imbarcazioni	1	1	0	0	0	2
commercio al dettaglio natanti e accessori	2	1	0	0	0	3
noleggio senza equipaggio imbarcazioni da diporto	-1	1	1	-1	-5	-5
totale servizi considerati	26	1	0	7	5	39

* the statistics derive from the total number of businesses in sector 30.1 SHIPBUILDING AND OTHER NAUTICAL CONSTRUCTION – A number of companies are registered only as 30.1, without specifically indicating the category as either 30.1.1 (construction of ships and floating structures) or as 30.1.2 construction of watercraft for sports or pleasure, which are the only two subdivisions of the nautical construction sector. During the period considered, companies classified only as 30.1 SHIPBUILDING AND OTHER NAUTICAL CONSTRUCTION without further specification, decreased noticeably in number, probably also because some of them were reclassified more in detail as 30.1.1 or 30.1.2;
** excluding engines.

Source: Author's own elaboration on data from Infocamere.

For the service activities connected expressly to the nautical sector, until 2009, the differentiation between the two geographical districts was quite definite and the province of Pesaro and Urbino had almost twice as many active enterprises as Ancona. In fewer than 10 years, the situation has changed profoundly and in 2017 found the two areas almost aligned as regards the number of businesses operating in the repair and maintenance of commercial shipping and pleasure craft.

It is worth noting that at the beginning of the period, the difference between the two districts in that aspect was sharp: in the province of Pesaro and the number of companies operating in the sector was almost three times that of the province of Ancona (accounting for 58% vs. 22.2%); in 2018 the gap had shrunk considerably (46.8% vs. 36.0%) and the importance of that type of specialization had grown in importance in the province of Macerata as well (from 8.3% to 12.6%).

Table 2: MARCHE - Companies active in the repair and maintenance of ships and recreational craft (excluding engines).

Anni *province*	*AN*	*AP*	*FM*	*MC*	*PU*	*Totale*
2009	16	6	2	6	42	72
2018	40	4	1	14	52	111
variazione assoluta	24	-2	-1	8	10	39
quote % delle aree provinciali per anno						
2009	22,2	8,3	2,8	8,3	58,3	100,0
2018	36,0	3,6	0,9	12,6	46,8	100,0
variazione punti %	13,8	-4,7	-1,9	4,3	-11,5	

Source: Author's own elaboration on data from Infocamere.

- *Distribution by Municipality*

There are a number of companies scattered throughout the district engaged in production and service to the nautical industry, even far from the coast, illustrating the vocation of the entire region to the production and service of the sector. This is particularly notable in the province of Pesaro where, for example, we find companies operating in the production of sports and pleasure boats and in services of repair and maintenance of ships and other vessels located in a number of inland towns like Mondavio (26 km from the coast), Cartoceto (15 km from the coast), Colli al Metauro (the union of Montemaggiore to Metauro, Saltara and Serrungarina, which are all, on average, more than 17 km from the sea).

In the province of Ancona, Trecastelli brings together the municipalities of Ripe, Castel Colonna and Monterado, on average more than 10 km from the coast (from Senigallia). In this municipal union, 6 companies operate: 2 in the construction of ships, 3 in the construction of pleasure boats, one in related repair and maintenance services.

Table 3: MARCHE - companies active in the main nautical activities (production and services) by municipality.

	30.1 navi e imbarcazioni (generico)	30.11 *costruzione di navi e di strutture galleggianti*	30.12 *costruzione di imbarcazioni da diporto e sportive*	33.15 *riparazioni e manutenzioni di navi e imbarcazioni da diporto (esc. i motori)*	**TOTALE**
An002 Ancona	13	20	3	27	63
An006 Camerano	0	0	0	1	1
An010 Castelfidardo	0	1	0	0	1
An014 Chiaravalle	1	0	0	0	1
An018 Falconara Marittima	3	3	1	4	11
An019 Filottrano	0	1	0	0	1
An020 Genga	0	0	1	0	1
An021 Jesi	0	0	1	0	1
An025 Monsano	0	1	0	0	1
An027 Montemarciano	1	1	0	1	3
An032 Numana	0	0	0	1	1
An034 Osimo	0	2	1	2	5
An035 Ostra	0	1	0	0	1
An036 Ostra Vetere	0	0	1	0	1
An041 San Marcello	0	0	0	1	1
An044 Sassoferrato	0	1	0	0	1
An045 Senigallia	1	2	7	2	12
An048 Sirolo	0	0	0	1	1
An050 Trecastelli	1	2	3	1	7
AN	**20**	**35**	**18**	**41**	**114**
Ap023 Grottammare	0	0	1	0	1
Ap045 Monteprandone	1	0	1	1	3
Ap066 San Benedetto Del Tronto	0	8	3	3	14
AP	**1**	**8**	**5**	**4**	**18**
Fm009 Campofilone	0	0	1	0	1
Fm019 Fermo	0	1	0	0	1
Fm060 Porto San Giorgio	0	0	1	1	2
Fm061 Porto Sant'elpidio	0	1	0	0	1
FM	**0**	**2**	**2**	**1**	**5**

	30.1 navi e imbarcazioni (generico)	30.11 *costruzione di navi e di strutture galleggianti*	30.12 *costruzione di imbarcazioni da diporto e sportive*	33.15 *riparazioni e manutenzioni di navi e imbarcazioni da diporto (esclusi i motori)*	**TOTALE**
Mc012 Cingoli	0	0	0	1	1
Mc013 Civitanova Marche	1	7	3	11	22
Mc015 Corridonia	0	0	1	0	1
Mc023 Macerata	0	1	0	0	1
Mc030 Montelupone	0	0	1	0	1
Mc043 Potenza Picena	0	0	0	1	1
Mc044 Recanati	0	1	1	1	3
MC	**1**	**9**	**6**	**14**	**30**
Pu007 Cagli	0	0	0	1	1
Pu010 Cartoceto	1	3	6	4	14
Pu013 Fano	17	15	51	27	110
Pu018 Frontone	0	0	0	1	1
Pu019 Gabicce Mare	0	1	1	0	2
Pu020 Gradara	0	0	0	1	1
Pu027 Mombaroccio	0	0	1	0	1
Pu028 Mondavio	1	0	5	0	6
Pu029 Mondolfo	5	6	13	6	30
Pu038 Monte Porzio	0	0	8	2	10
Pu043 Pergola	0	1	0	0	1
Pu044 Pesaro	6	1	8	5	20
Pu051 San Costanzo	2	1	2	0	5
Pu054 San Lorenzo In Campo	0	1	0	0	1
Pu059 Sassocorvaro	0	1	0	0	1
Pu069 Colli Al Metauro	3	1	4	4	12
Pu070 Terre Roveresche	0	0	4	1	5
PU	**35**	**31**	**103**	**52**	**221**
Totale complessivo	**57**	**85**	**134**	**112**	**388**

Source: Author's own elaboration on data from Infocamere.

- *Workforce*

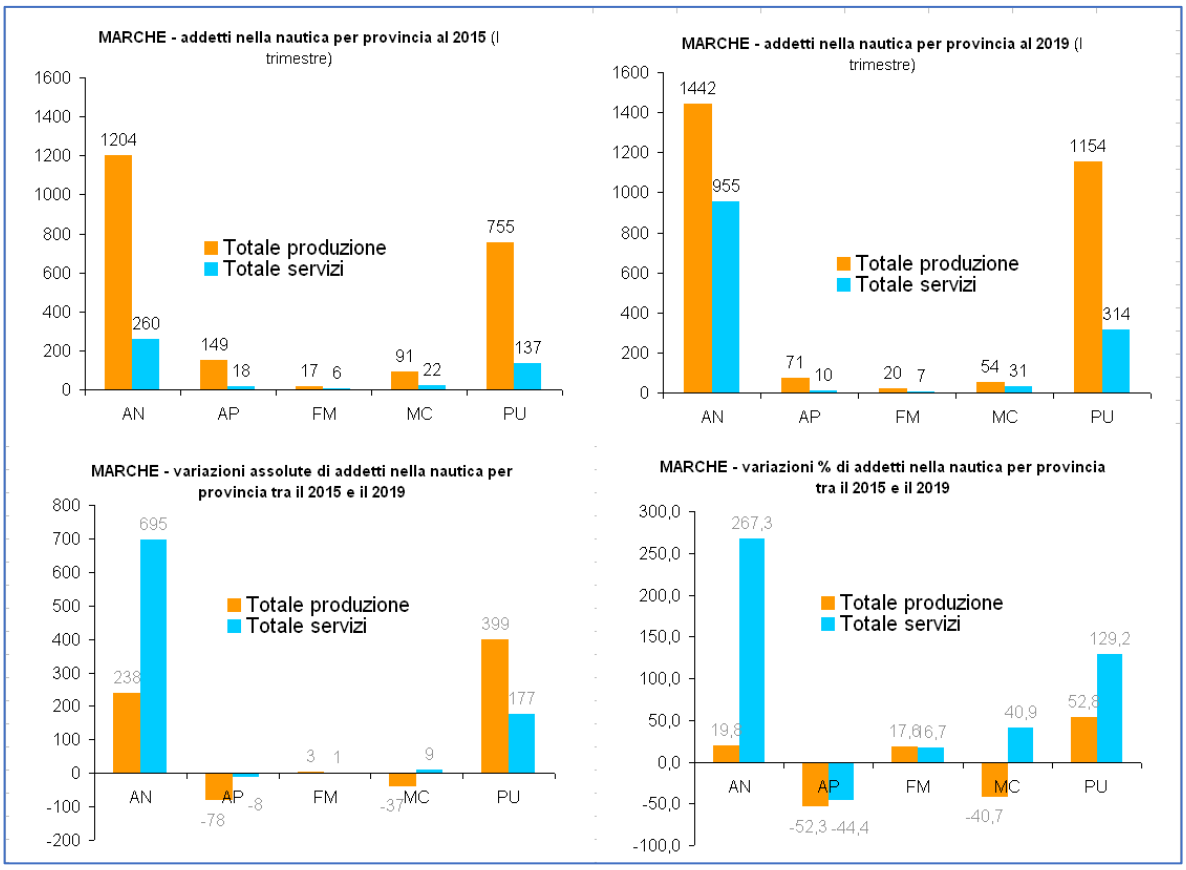
1. *The dynamic according to Infocamere data*

Based on the data published by Infocamere relative to the workforce employed in the active companies, we can observe how in just four years (2015-2019) enterprises in the nautical industry engaged in production and service in the region increased their workforce by over 50%, with almost 1400 more employees. Growth has been particularly intense in the two main provincial districts where employment increased at the same rate, about 64% more. But taken separately, the dynamics of production and services show a different development from the occupational standpoint: while in the province of Ancona, the increased employment was centred in service activities, for the province of Pesaro and Urbino the growth was greater in the production sector.

More in detail, shipbuilding in the Ancona area grew by 238 workers (+19.8%) thanks above all to the contribution of additional employment in the construction of large vessels and floating structures (+22.1%). Throughout the province, services to the nautical industry grew by 695 employees thanks above all to the strong occupational growth of businesses engaged in the repair and maintenance of cargo ships and pleasure craft (+687, or +316.6%). In the province of Pesaro and Urbino, employment in the shipbuilding sector grew by 399 workers (+52.8%), concentrated in the production of sports and pleasure craft (+363, or +78.9%); the increase in the number of employees

in the services is not as high in absolute terms (+177 workers, but more intense in relative terms (+129.2%).

Figure 5: Nautical employees per province.



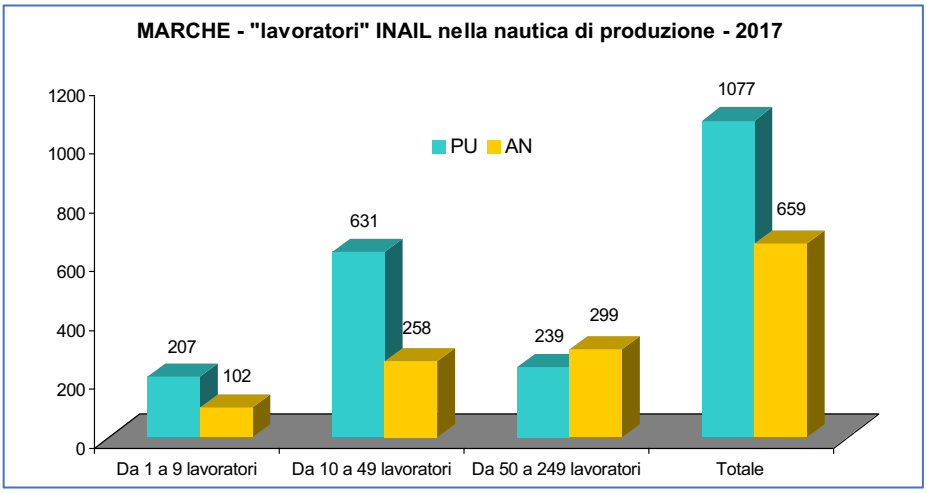
Source: Author's own elaboration on data from Infocamere.

2. *Distribution by size of the companies according to INAIL data*

INAIL, which considers the "workers"[2] and the companies in which they work, enables us to analyse the distribution by size class of the enterprises. The difference between the two main provincial nautical districts is significant: with reference to the total number of shipbuilding companies, the province of Pesaro and Urbino reports more employees than the province of Ancona in the segment of micro-enterprises (1-9 workers) and small enterprises (10-49). The province of Ancona reports a greater concentration of workers in the segment of medium enterprises (50-249 workers).

[2] This is the "unit of labour/year estimated based on the salary mass that the employer declares to pay with reference to the quantity of work done. In particular, the employees are calculated as the ratio between the mass salaries declared and the average daily wage times 300. "Independent workers" (business owners, partners, and family employees), however, are covered by the insured heads. The number of workers/years do not include those categories of workers (apprentice artisans and non-artisans, members of cooperatives of dock workers or fishermen, etc.) whose payment is not reported as the premium is not connected to them. Also excluded from the count are contract workers (formerly temporary workers).

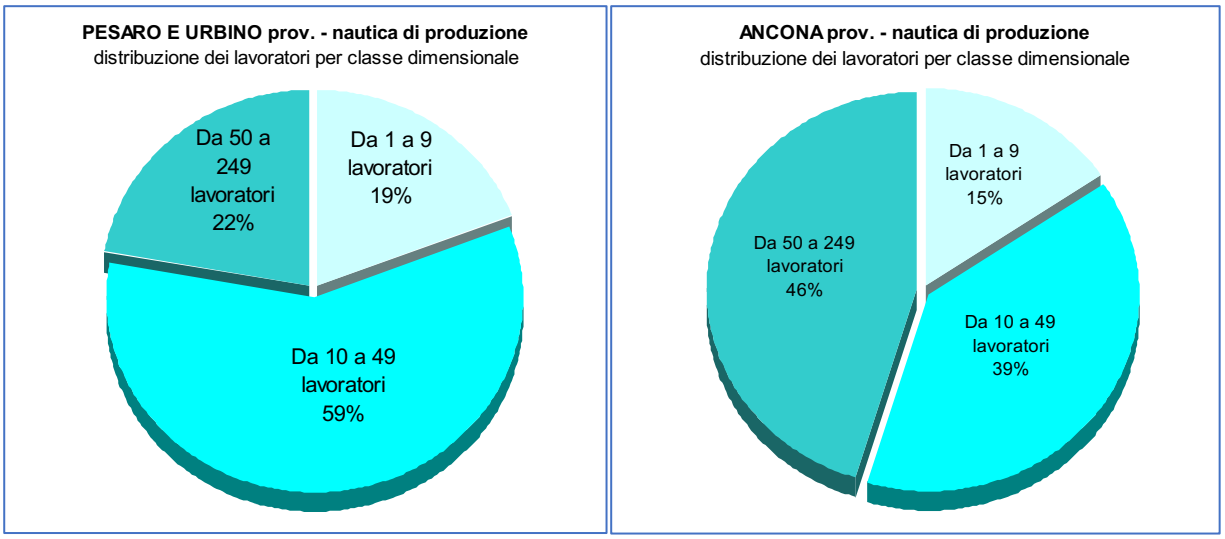
Figure 6: INAIL nautical production employees.



Source: Author's own elaboration on data from INAIL.

Consequently, the breakdown by size classes of the shipbuilding industry is decidedly characterized by employment in medium-sized companies (46% of the workers) in the province of Ancona, and by small companies (59%) in that of Pesaro and Urbino.

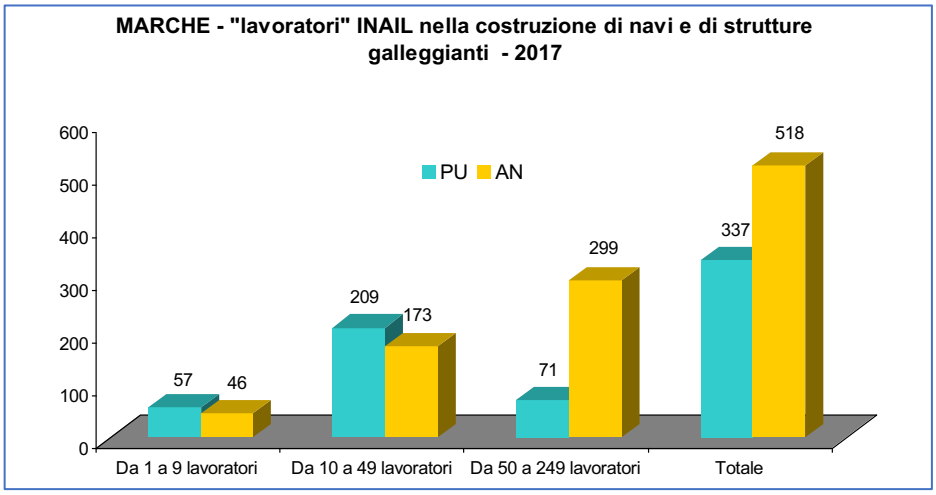
Figure 7: Breakdown by size classes of nautical production.



Source: Author's own elaboration on data from INAIL.

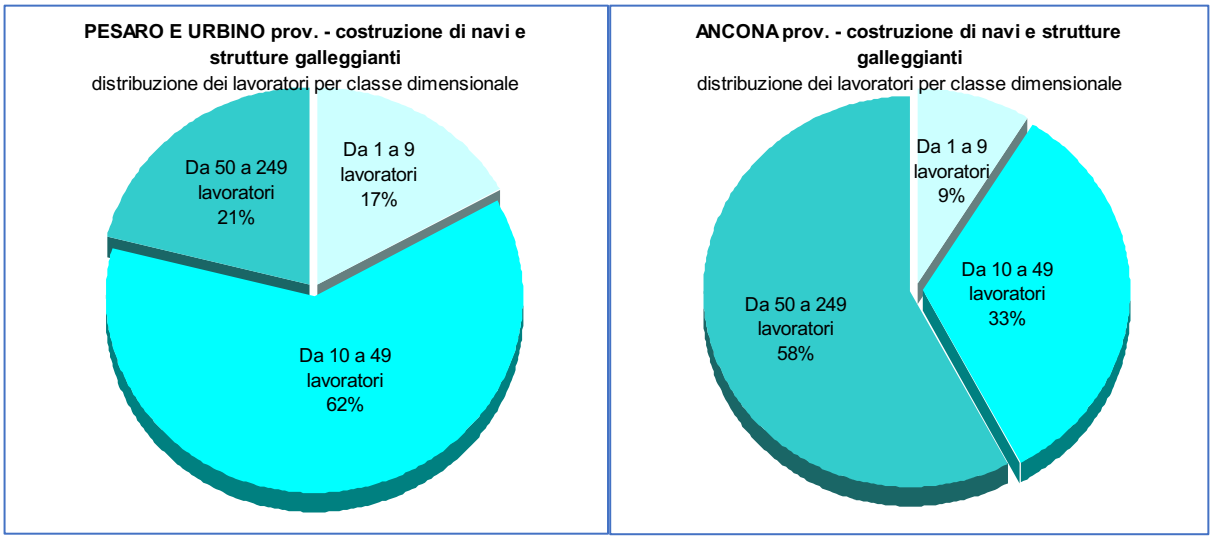
The difference is even more accentuated if we consider the construction of large vessels and floating structures, where the role of medium-sized enterprises in the province of Ancona and small enterprises in the area of Pesaro and Urbino is even more marked.

Figure 8: INAIL employees in the construction of ships and floating structures.



Source: Author's own elaboration on data from INAIL.

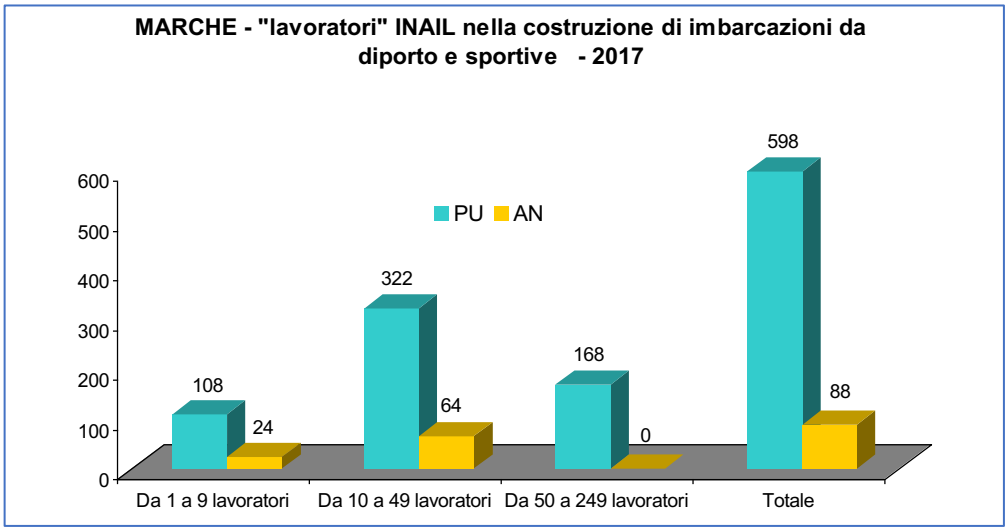
Figure 9: Breakdown by size classes of nautical production.



Source: Author's own elaboration on data from INAIL.

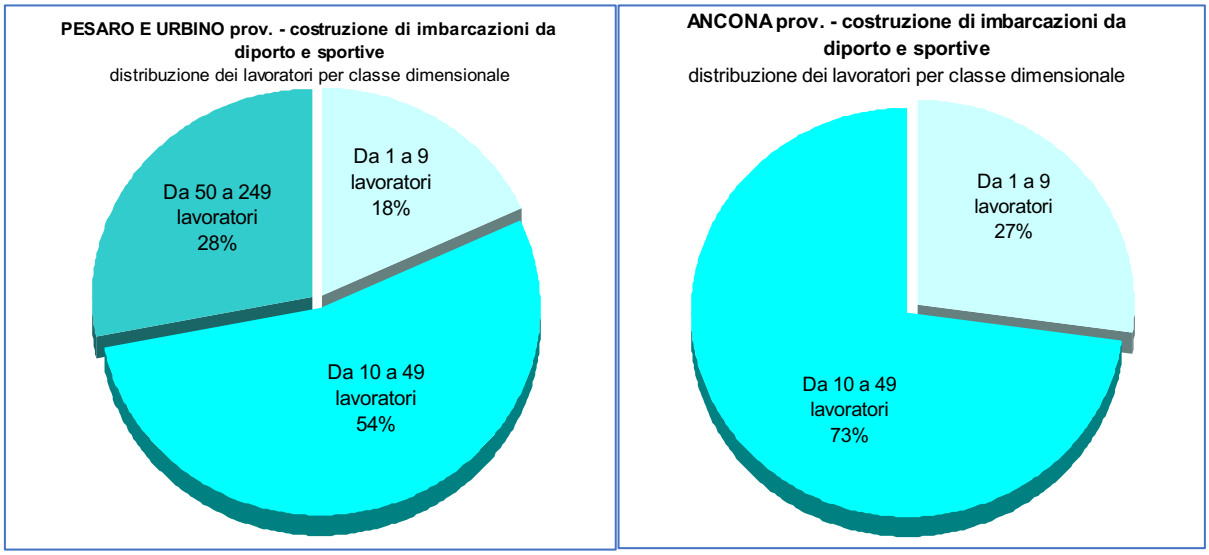
For sports and pleasure craft, the difference is particularly sharp, and the "specialization" of the province of Pesaro and Urbino is also characterized by a more balanced distribution of occupation by size class, with a large number of workers employed in medium-sized industries (28% of the cases). In the province of Ancona, however, these companies tend to be micro and small in most cases.

Figure 10: INAIL employees in the construction of recreational and sporting boats.



Source: Author's own elaboration on data from INAIL.

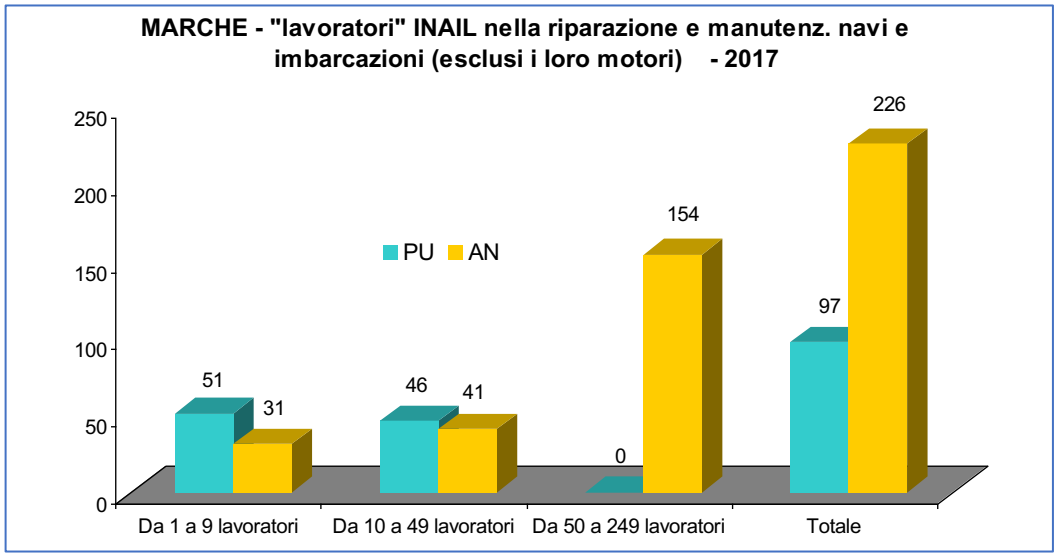
Figure 11: Breakdown by size classes of nautical production.



Source: Author's own elaboration on data from INAIL.

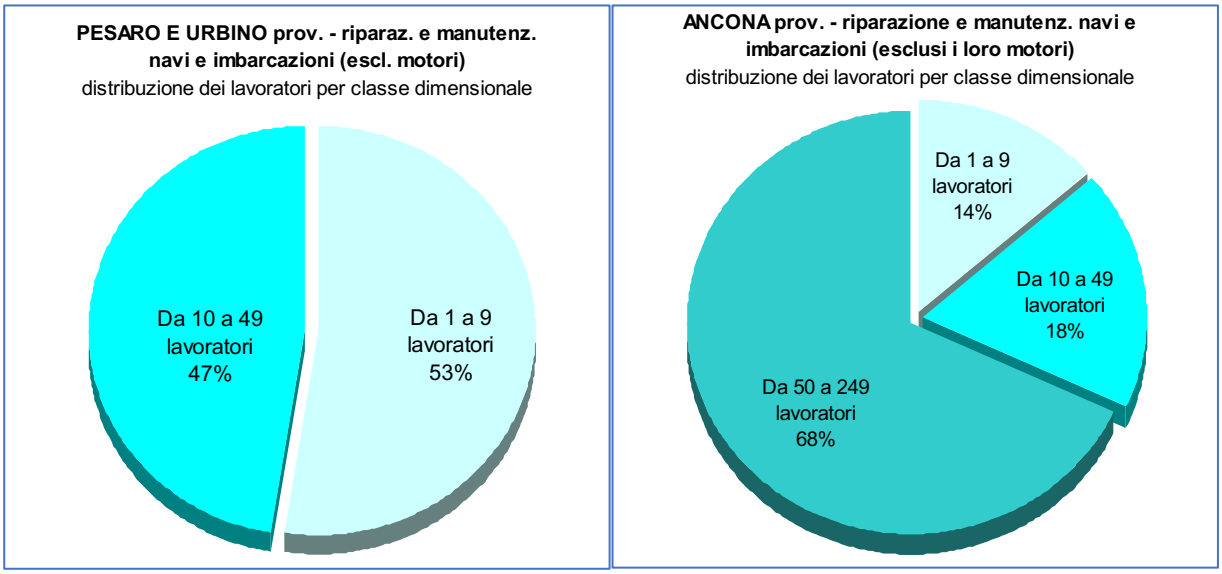
The most significant service enterprises in the sector remain concentrated in the province of Ancona, and also in this case the location corresponds to a distribution of employment by size classes where they are concentrated mainly in medium enterprises (68% of the workers) non-existent in the Pesaro district. It is further confirmation of the different yet complementary character of the organization between the two main districts of the regional nautical industry: that of Pesaro and Urbino more focused on the production of pleasure craft and while Ancona looks more toward the construction of ships and large pleasure vessels for passengers, as well as activities of maintenance and repair.

Figure 12: INAIL employees in the repair and maintenance of ships and boats.



Source: Author's own elaboration on data from INAIL.

Figure 13: Breakdown by size classes of nautical production.



Source: Author's own elaboration on data from INAIL.

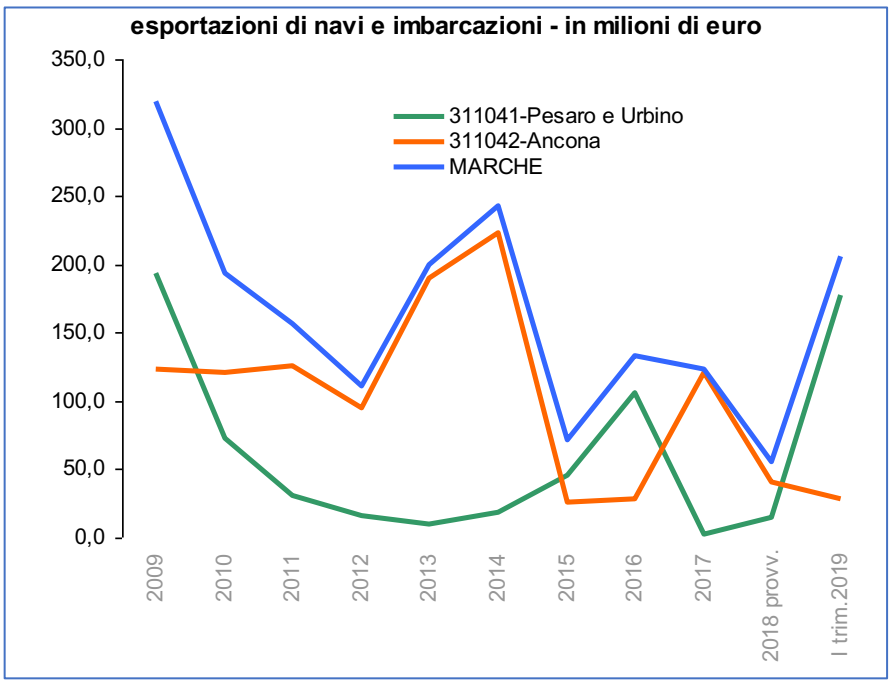
- *Exports*

From January 1 to March 31, 2019, the companies in the Marche region exported goods for 3 billion euro compared to 2.8 billion in the same period of the previous year, up 167.2 million euro (Battaglia 2019). Manufacturing activities "covered" all most all the regional export trade, for a total of 2.9 billion euro; in particular, exports of means of transportation and, in this category, watercraft. The dynamics of export trade in ships and other vessels from the two leading provincial districts of the nautical region exhibit a decreasing trend, due mainly to the performance of exports from the province of Ancona. Significant fluctuations have been linked to the types of products exported, almost always luxury yachts with very high unit value. Data from the first quarter 2019 is particularly

interesting because, though it only refers to the first quarter, it is already higher than that of each of the four previous years.

Among other things, the fact that the two most significant districts of the region's nautical industry are characterized by different product orientations and roles in the supply chain of the sector, enables them to exchange places frequently in acting as the primary source of attraction of foreign demand, indicating an overall competitiveness of the sector that thrives on the complementary interaction between the two districts. The excellent image that the luxury yacht construction of the Marche region has regained and is building on, takes advantage of a time of strength of all three elements of the regional nautical industry (large passenger vessels, production and refitting of mega yachts, maintenance, and repair) as two of the main industries in the area (Pesaro-Fano and Ancona).

Figure 14: Export of ships and boats (in millions of euro).



Source: Author's own elaboration on data from ISTAT-COEWEB.

Table 3: Export by Year and Italian Territory according to product classification: Classification by economic activity (Ateco 2007) Reference period: 4th quarter 2018 – Cumulative data in millions of euro.

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018 provv.	I trim. 2019
PU	193,6	72,3	30,7	15,9	9,8	17,9	45,2	105,4	2,2	14,3	177,7
AN	122,8	120,4	125,5	95,4	189,7	223,5	26,4	27,8	120,5	40,1	28,4
MC	0,2	0,2	0,1	0,1	0,1	0,6	0,0	0,0	0,1	0,6	0,0
AP	3,0	0,1	0,0	0,0	0,0	0,4	0,0	0,1	0,0	0,0	0,0
FM	0,0	0,0	0,0	0,0	0,0	0,0	0,1	0,0	0,0	0,0	0,0
MARCHE	319,6	193,0	156,4	111,3	199,6	242,3	71,7	133,3	122,8	55,0	206,0

Selected filters: Commodity (Ateco 2007) CL301-Ships and Vessels; Selected filters: Country 1033-[WORLD]

Source: Author's own elaboration on data from ISTAT-COEWEB.

Table 4: Analysis of the Marche Region's exports of ships and boats by provincial area (highlighting the provincial area in first place for exports in each year).

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018 provv.	I trim. 2019
PU	60,6	37,4	19,7	14,3	4,9	7,4	63,1	79,1	1,8	26,0	86,2
AN	38,4	62,4	80,3	85,7	95,0	92,2	36,8	20,8	98,1	72,9	13,8
MC	0,1	0,1	0,1	0,1	0,1	0,2	0,0	0,0	0,1	1,0	0,0
AP	0,9	0,0	0,0	0,0	0,0	0,2	0,0	0,1	0,0	0,0	0,0
FM	0,0	0,0	0,0	0,0	0,0	0,0	0,1	0,0	0,0	0,0	0,0
MARCHE	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0

Source: Author's own elaboration on data from ISTAT-COEWEB.

4.4 *Initiatives and Experiments to foster the Development of the Shipbuilding Industry in the Marche Region*

To perform an in-depth analysis of the performance and prospects of the sector in the region, it will be helpful to reconstruct the events that have involved and, in some way, continue to affect the nautical industry of the Marche region. In 2003, the European shipbuilding industry was characterized by an unprecedented drop in new orders and unbridled competition, in particularly from the Far East. Effectively, the contribution to the GDP of the EU countries by the maritime "cluster", e.g., all the industrial activities (shipyards), shipping lines (fleet) and services that had the sea as their common denominator and core business, did not quite reach 3%. The repercussions of this situation obviously also involved the Marche region.

Alongside the struggling shipyards, however, the rapidly developing pleasure craft segment was able, at least in that region, to bring the sector back into some sort of balance.

In the Marche region, the nautical industry is considered one of the excellences of Italy's entrepreneurial system. It is a structured system divided between large and small companies, able to compete at the international level while providing opportunities for smaller businesses in a dense network of suppliers. While the Ancona district excels in the production of mega-yachts, other districts offer a wide range of shipyards and boatyards for smaller craft and for refitting, some of which operate at the highest levels of excellence. For this reason, the Marche region, starting in 2004, lobbied to have its productive supply chain of pleasure craft recognized as a "Nautical Industry District", alongside other traditional districts that form the basis of the regional economy.

From the outset, the project stood out as an expression of the ability of the enterprises and local institutions to develop a strategic process that, in the long run, could become a Marche trademark. The main actions undertaken were:

- developing a mid-term strategy that would facilitate a rationalization of the existing resources on the basis of the needs of the local economic system and the district involved;
- facilitating synergistic mergers and collaborations between different economic entities and increase the opportunities for expansion of the offering at a more competitive level;

- encouraging mechanisms capable of aiding in the acquisition of financial resources both with respect to the credit system and through laws and programs initiated at the regional, national and EU level;
- encouraging and supporting programs of innovation, privileging those that facilitate integration between different sectors and ensure a greater economic and social yield through the identification of strategies capable of accessing existing Community funds;
- fostering the internationalization of the system with particular reference to an EU-based approach to markets where there is new demand, by organizing encounters with industrial systems and research organizations at the highest levels.

The improvements in sales and quality positioning that characterized the sector, starting from the year 2000, were badly undermined by the economic and financial crisis of 2009, which led to a reorganization of the entire nautical sector, affecting production (including the design of new models more and more in line with the changing needs of the markets, offering innovative and distinctive solutions) and in the approach to the market. Many shipyards went out of business and new companies appeared in the district, alongside the historic companies.

Among the assets of the Marche's nautical system is Marina Dorica, the tourist port of Ancona that, with berths for over 1,320 boats in the water (including jetties on floating wharves or chains, and 258 on land – connected to a whole series of services that can be used and consulted in the special section of the website (http://www.marinadorica.it/servizi/) – is one of the most important harbour facilities on the Adriatic, not only for the positive growth rate it has shown, also in the sports sector (it hosts a number of national and international events) and in recreational boating (Marina Dorica is on the calendar of events of the Adriatic-Mediterranean Festival). Inaugurated in September 2000 and awarded a Blue Banner since 2011, Marina Dorica is one of the largest and most modern tourist ports in Italy and has been selected among the "TOP 30 MARINAS OF ITALY 2012", and one of the best and most appreciated ports for safe docking on the Italian coasts.

The excellences of the Marche's nautical industry are not limited only to manufacturing, but involve a number of post-production sectors as well. Among these, until 2011, the "FANO YACHT FESTIVAL", was an important showcase in the Adriatic (alongside similar events in Venice, Brindisi, Jesolo and Rimini), albeit with some limits, mainly relative to logistic, such as the impossibility to berth exceptionally long or high tonnage vessels. Moreover, thanks to the development of the of accommodation structures in the tourist port sector, including "Marina Dorica", and the expansion of the so-called "small shipbuilding" business, present for years in the port of Ancona industrial area known as ZIPA, Fosso Conocchio delta and the new tourist port in concession to La Marina Dorica Spa – development in the Marche region of the nautical industry has had a

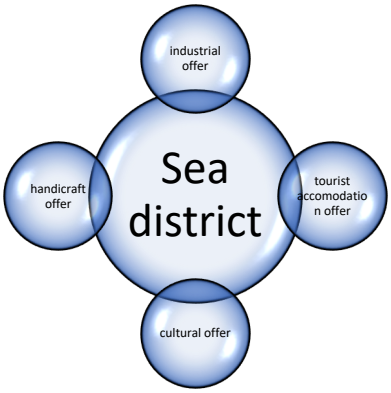
primary role in the field of services connected to pleasure boating. During the same period, ISA Produzione Srl, a company of the Rodriguez group, developed a project called "ANK'S Marina" which called for construction of harbour accommodations and a series of tourist services for large yachts that would make it a reference for the entire Adriatic area for the cruise market and rental of mega yachts, through the synergies that could be created between the existing accommodation structures, then engaged in a process of expansion; plans for the construction, maintenance and repair of boats and yachts and the possibility of providing technical, logistic and tourist services.

Outline of ANK'S MARINA project

With the realization of the "ANK'S Marina" project, the intention was to lay the groundwork for establishing the model of a network that would generate a series of synergies among the potential participants of the proposed Nautical District. The main participants can be summarized as follows:

- a strong nautical industry to develop harbour accommodations and tourist services capable of competing successfully with the Mediterranean competition by providing a safe berth. equipped with drinking water, electricity, fuel, professional technical service as well as facilities and connections to visit tourist sites inland. It will be essential to acquire the relative know-how for the management and movement of mega-yachts, as well as providing the services appropriate to that type of vessel;
- service enterprises linked to the industry (maritime agents, shipping companies, etc.);
- industries of carpentry and cabinetry;
- suppliers of furnishings and fittings for interiors;
- hotels and tourist accommodations in general;
- retail businesses and shops;
- artistic craftsmanship;
- design of custom furnishings to measure and custom products in general;
- small business in the mechanical/systems Made in Italy sector with high value added;
- agri-food industry, focusing on typical products (with the creation of itineraries with specialized guides and a program for a master's degree in management for food & wine tourism);
- valorisation of the scenic, artistic and cultural heritage of the region;
- telecommunications industry for the implementation of network standards and the creation of networks that facilitate collaboration between companies, but also between students, scholars, research labs and universities;
- an advanced services sector, especially with regard to information technology, communications and promotion, logistics support, information about foreign markets, permanent professional training, orientation for the managerial culture to manage, create and anticipate innovation;
- human capital in the region whose valorisation is the most important factor critical to the success of the project. Close ties of collaboration, with constant exchanges of information, will be established between the universities and the various institutions existing in the region, to implement programs of integrated training, considering that the construction of luxury motor yachts requires extensive skills and exceptional professionalism, in both the technical and creative fields, as well as adequate management of all the relative services that local docking demands;

• Universities and research organizations concerned with the development and experimentation of new materials, environmental protection, safety in the workplace, environmental impact, health and quality of life, innovative systems of handling and logistics management focused on the sector of large and medium-sized yachts, etc.



•Institutions – In Europe there are about 105,000 local communities that can offer economically attractive conditions. In light of this fragmentation, the efforts toward alliance and coordination among the institutions takes on increasing significance.

The activities of research appear to have led to the creation of new companies with high technological content, offering a guarantee of gradual implementation of the model consisting of connecting current skills of the "high-tech" companies to set off a virtuous process of continuous regeneration.

Concluding, the model of a network based on a strategic project that can work across many borders to unify different districts (even at the transnational level) with a similar vocation: making the Marche region competitive, arriving at integration of the structures, infrastructures, and know-how by enlisting the cooperation of all the players in the area. In that sense, the strategic positioning of the Marche region and of Ancona at the centre of the Adriatic was crucial, because it would guarantee a rapid acceptance of this initiative and its immediate success.

More recently, at a more academic level, it is important to mention the Blue Tech Adrion Cluster. This is a project co-financed by the "Target call on European Strategy for the Adriatic and Ionian Region – EUSAIR IPA Cross-border Cooperation 2007-2013". Since the outset, the project proposed to contribute to the development of a macro-regional cluster in the sector of green technologies applied to naval construction in the Adriatic-Ionian area, in an effort to pursue the goals of the EUSAIR Strategy – Pillar 1 «Blue Technologies», through the implementation of a feasibility study for a networking and promotional platform for the area.

The project intended to support the implementation of the active branch of Blue Growth - EUSAIR, which provides incentives in support of projects in the sector of Blue Technologies through actions tending to foster the development of macro-regional clusters in the sectors of green ship-building and the development of platforms of collaboration between institutions and research centres engaged in the development of innovation and blue technologies, and encourage the mobility of research personnel in this specific sector.

4.5 *Discussion and Considerations on the Shipbuilding Industry in the Marche Region*

4.5.1 *Critical Aspects*

As we have already noted, the nautical sector is a complex cluster that includes luxury shipbuilding and subcontracting companies. The shipbuilding sector is divided among pleasure craft, cruise ships, military vessels, and other smaller facilities. In Italy, about 200,000 companies are involved in seafaring enterprises and about 4,000 of these are located in the Marche region alone. Much of the blame for the failure of economic development in the shipbuilding sector can be attributed to the lack of clear focus of the policies enacted from 2003 until the present time. From the idea of establishing the District of the Sea, never concretely implemented, that of the nautical industry in the Marche region is a supply chain that has "tended to improvise" for the last 50 or so years and appears still unable to fully grasp the importance of establishing an independent regional identity.

One problem in cultural terms is the difficulty of achieving aggregation within the network; there is no structured system of interwoven cooperation, no actual cluster, as the more successfully developed Italian nautical districts have demonstrated in places like Viareggio, Livorno and La Spezia. Moreover, the sector of professional training is especially deficient: while the political sphere has been unable to develop valid processes in this connection, we watched the demolition of the former Nautical Technical Institute of Ancona, a school that should be considered vital to a region with an important shipbuilding industry. It would be important to establish a "regional trademark of quality" for the sector, capable of applying and developing high quality production processes, accompanied by excellent training courses, in order to develop a skilled workforce able to support those high-quality processes.

Lastly, in the Marche region there is a major problem of representation. At the regional level, witnesses report the lack of synergy between the associations that represent different categories and between them and the businesses, toward which they should act as facilitators of connection. Even at the national level, the lack of a single organization is crucial when it comes to programming political strategy: the dual representation (UCINA and NAUTICA ITALIANA) has unquestionable fallout also on programming at the local/regional level.

1. *The subcontracting Supply Chain*

The "nautical shipyard supply chain" is complex: its three main subdivisions are:

1) construction and repair of ships and boats;
2) production of nautical equipment and instrumentation;
3) production of pleasure craft.

Research on the potential for development of the supply chain takes two different approaches:

1) the consumer side (the naval shipyard)
2) the supplier side (both effective and potential) regarding products or services, representing the main segments of procurement for naval shipyards.

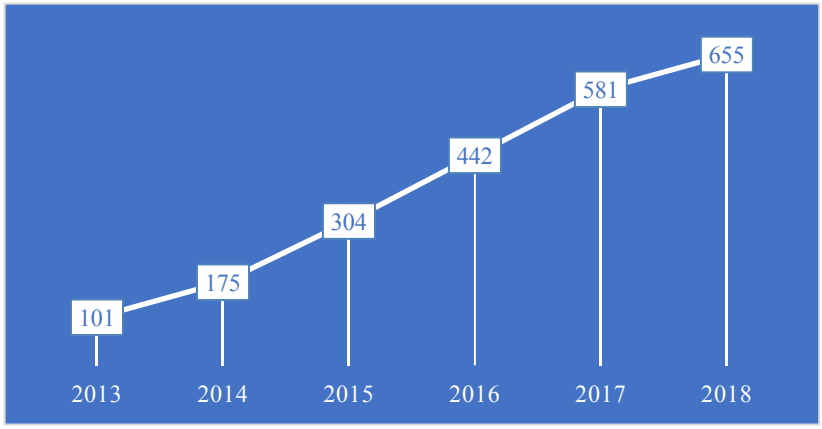
We interviewed a number of directors/managers of shipyards and contacted a sampling of subcontractors selected on the basis of the type of product, quality and structure of relations established with the shipbuilding sector. We also interviewed privileged witnesses for the purpose of identifying the requisites, in terms of both investment and of human resources and training, necessary as input for the creation of an industrial policy that reflects and satisfies the needs of the area.

2. *Prospects for shipbuilding*

The region is home to a number of the world's leading producers in their respective field of competence: among them are Fincantieri, leader on the market of cruise ships and ferries, Cantiere delle Marche, the ISA/Palumbo group and the CRN Ferretti group, all major players whose role is steadily growing in the sector of yacht and mega-yacht production; finally, Cantiere Rossini, specialized in refitting. The performance of the region is still greatly influenced by the extraordinary growth of exports in the nautical sector, which jumped from 40 million in the first 2018 to 290 million in the same semester 2019 and which corresponded to a value of 2.6% of the total exports from Italy, compared with 2.5% in the first half of 2018 (Battaglia 2019).

With respect to the curve shown in Figure 1 in the Introduction for the performance of the sector in the period 2000-2018, after the financial crisis, and specifically from 2013 on, the Italian nautical industry experienced a period of steady growth. Illustrating the incidence of the regional nautical industry in this period of growth, Figure 15 shows the total value of production reported by the companies concerned. The estimated values, in millions of euro, extrapolated from their financial statements reveal a trend of the sector at the regional level that reflects the growth reported at the national level from the same year, 2013.

Figure 15: Marche's boating industry: trend in production value (2013-2018, in millions of euro).



Source: Author's own elaboration from Battaglia 2019.

As the main source of employment, the Ancona shipyard (Fincantieri group) is the only organization in the Marche region that operates in the construction of large passenger ships.

In general, the number of workers employed by the companies tends to vary from small, in companies specialized in refitting, to very large in the case of companies specialized in the construction of luxury yachts and/or cruise ships. Specifically, the former will have about 10 employees while the latter may have as many as 3000 or more, every day, on two shifts.

3. *The dimensions of the shipyards*

In examining in detail, the value of production reported by the shipyards in the two-year period 2017-2018, the interviews did not always yield the economic values requested, either for reasons of confidentiality within the company, or for the impossibility of collecting the data at the time of the interview. In any case, the information provided can offer interesting notions when reflecting on the significance (in percentage) of the domestic and foreign market. Despite the lack of data for the above reasons, and because in certain cases we refer to known, centralized data, in the case of structures with several productions' plants scattered throughout the country it is possible to consider one factor common to all shipyards. The reports of the interviews show clearly that the values of production are generated principally by the foreign market. In the words of the people we interviewed, turnover is expected to increase for the current year, as shown by the data reported by several of the shipyards studied: in the first quarter of 2019, the trend continued positive for turnover, both in the production of vessels and in maintenance. The data were highly significant and testify to the persistence of the current period of strong expansion of the sector.

The great impact of foreign sales on turnover is not, however, an indicator through which it is possible to identify and localize production. Except for one shipyard which has expanded its activity abroad considerably, though it maintains an Italian nucleus with eight plants located in different Italian regions, the remaining shipyards examined do not have any major structures outside of Italy. Despite the extensive use of international distributors to deliver worldwide, the production is Italian. We should also note that in one case, the company in question has no immediate plans to open a facility abroad. On the contrary, joint venture agreements have been signed with a shipyard in Ravenna to be able to operate in a mooring dock from 180 ft. up.

4. *Current management of subcontracting*

The breakdown of the value of the volume of turnover generated by the subcontractors is of key significance if we want to pinpoint in which segments and to what extent the turnover is generated within the region. From the reports, it can be seen that, especially for the shipyards operating in the sector of new vessel construction, subcontract work does not have very great economic fallout in the

Marche region. This is due to the fact that procurement, including parts, involves supplies that are naval and must therefore have specific and highly particular characteristics – including quality certifications – of which the region does not seem to ensure widespread availability. In any case, the companies interviewed confirmed the existence of structures of excellence within the regional fabric, which participate actively in the subcontracting business. Timely response and flexibility are felt to be the most useful strategies, considering the size of the SME in the area. For fiberglass constructions, between Fano and Mondolfo there are a number of good companies that, however, do not satisfy all the demands of the shipyards. Certain other sectors are felt to be largely unsatisfactory or absent, such as: 1) carpentry, declared a sector in crisis, with no companies in the Marche region ready to fill the gap; 2) shipboard carpentry, aside from a few companies between Fano and Mondolfo – due to the important presence of the Pershing Shipyards, now an integral part of the Ferretti group.

Other references are made with regard to a few companies that have been directly absorbed by the historically better-structured shipyards, like the Ferretti Group and the Cantiere delle Marche. If we attempt to estimate the fallout within the regional fabric, based on our interviews, we see that this is an item that most of the shipyards tend not to report, due to the difficulty in dividing the turnover generated based on the type of subcontract, and to the fact that it varies from year to year depending on the order. If, in general, and from the reports of those interviewed, it appears that for shipyards specialized in refitting, 90% of their purchases are made from local subcontractors (with isolated cases of contracts outside the region, often recommended by the client), for the more specialized and better structured shipyards engaged in the construction of new vessels, purchases from local subcontractors are only marginal. In view of the variety of the output, it is impossible to generalize, but it would appear that for shipyards operating in the construction of new vessels the following incidence of the segments on the volume of turnover of purchases are worth considering:

Table 5: Volume (%) subcontracting use.

Subcontracting Segment	%
Site services	1-3
Processing	25-30
Outfitting	25-28
Plants and Hi-Tech	10-15
Engineering	1-3
Purchases (*engine, transmission, external fittings, accessories, ...)*	15-20
Total	100

Source: Author's own elaboration on interview data.

In the management of relations with subcontractors, the shipyards do not report exclusives and it appears that a relationship of this type is not wise in terms of quality. Indeed, there does not

appear to be any competition among the shipyards with regard to subcontracting, and there is demand enough for all. We can speak, however, of "direct relations" and it is worth noting that, for example, in the sector of carpentry and metalwork, the same subcontractor may provide a technical manager who interfaces with the technical office of the shipyard to share production processes, and a "stable" operations manager who assists with logistics and assembly. It is this direct provision of qualified personnel that the subcontractor guarantees, and that facilitates its direct relationship with the shipyard.

The persons interviewed revealed that this is true to some extent for the segments of subcontracting handled. The sole exception is painting, which does not require those services.

In the management and assignment of different processing stages or different production processes to subcontractors, the interviews revealed a situation that is far from uniform and highly particular, depending on the type of shipbuilding company. Companies specialized in refitting handle subcontracting independently and, depending on the type of product or service needed, select the supplier case by case. Almost all labour is contracted, mainly locally, unless the ship owner requests a specific supplier. For companies engaged in shipbuilding per se, there are additional distinctions:

- In the case of a public company such as Fincantieri, the system is largely centralized; the entire logistic sector is organized and handled elsewhere, with large companies specialized in the sector that work exclusively for the shipbuilder in question. This means that the related activity generated by a shipbuilder, rather than being local, is international. Electrical and mechanical maintenance are generally handled by local businesses, as are services related more directly to the company (cleaning, loading, and unloading goods). The vast majority of supplies come from outside the district, often even beyond the national borders. Selection is not made in Ancona but is regulated centrally based on a "list of qualified suppliers". To be listed, a company must satisfy a number of specific requirements and provide information about its financial solidity, regular payment of employee salaries and contributions, certifications, etc.) A special committee for the evaluation of subcontractors periodically decides whether to stipulate or maintain a contract. With regard to certification, all subcontractors have to have documentation certifying the specific requisites and the workers must all be regularly employed (in the companies that do contract work for Fincantieri, the employees are mostly foreigners (about 50 different nationalities: African, Brazilian, Romanian, etc.) Fincantieri checks that everything is regular, gives courses on the security of the contributory aspect linked to the issue of the subcontracts' list, and some companies are also required to provide environmental certification. It should also be added that in this

connection, the Italian police, carabinieri and financial police are required to carry out normal surveillance with regard to fraud or other illicit conduct.

- In the case of private shipyards, the management is independent, under a worksite manager who is in charge of production, specific to the shipyard involved. Guidelines or technical outlines are provided, with which every supplier must comply. Engineering is internal, with possible recourse to the support of outside offices. Great skill and strict management, as well as excellent programming capability over the long term, are all characteristics that the successful shipbuilders possess internally. They enable the companies to focus on a very narrow selection of subcontractors whose ability to maintain the same high-quality standards is assured.

The management of a shipbuilder-subcontractor relationship is highly complex. The dynamics are worthy of further assessment and deeper study, in order to pinpoint the critical aspects that could be seen as opportunities in considering a strategic programming by the institutional bodies in the area. Comparing the responses of the personalities interviewed, we can already point to a number of elements:

1) The level of professionalism in the companies is not uniform and not all are able to ensure that the quality available in the district finds its way on-board. Generally, the artisans behave correctly and the more an order is specialized, the higher the level of quality, the more excellences are involved. Other skills such as those required in the scaffolding sector, may involve lesser levels of professionalism, even though erecting the scaffolding for a ship requires different and specifically nautical skills from those necessary to erect the scaffolding for a building. Also, “reliable” scaffolders, in terms of respect of the safety regulations on the job, are hard to find.
2) The crucial aspect of flexibility is involved in every stage of production: the good organization of labour and management of the timing, when several enterprises are at work simultaneously, are extremely critical. This is true not only because certain activities like painting and welding cannot overlap, but also because the shipyards complain of subcontractors’ tendency to underestimate the timing needed for a job. They make an offer which is later followed by a request for “overruns” due to delays or to failure to meet the timing originally indicated, which requires additional negotiation to make “adjustments” while the work is ongoing. These add further economic burdens to an already complex production process.
3) Long-term subcontractor management: for some companies, it is essential to be able to manage many orders, which ensure the consequent economic growth of both shipyard and subcontractor. More attention to the management of the smaller artisanal businesses seems

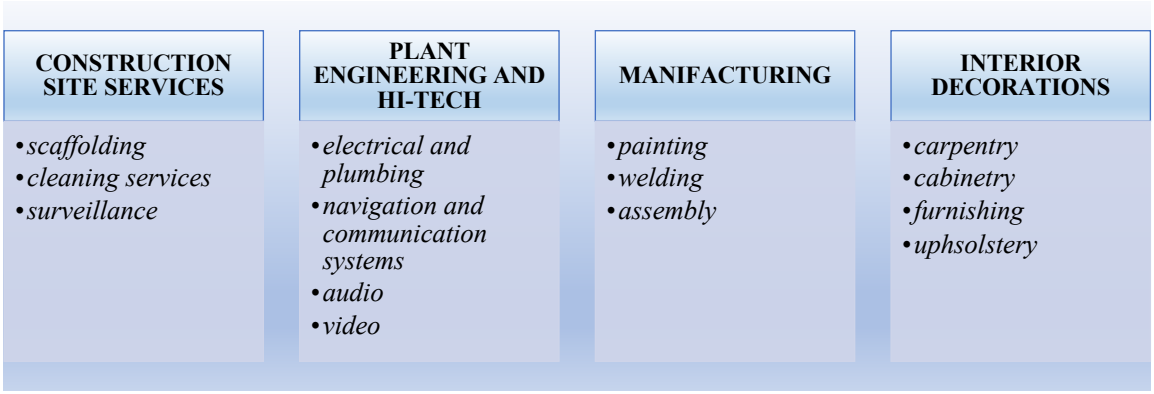
necessary, rather than to the large industries, coordinating the growth of the subcontractors, in step with that of the shipyard.

4) The difficulty of management of the life cycle of orders: generally speaking, the life cycle of an order ranges from 24 to 30 months, including 15 months of construction at the shipyard. Even just closing the deal on a contract can take from 4 months to 3 years. The need of special skills and knowledge adequate to manage such extreme time period is obvious.
5) Lack of proactivity and initiative on the part of subcontractors: more focused action on both factors would ensure more space in terms of "employability" and economic return. Considering what we learned from the interviews, the failure to move in this direction appears due to a lack of culture and knowledge relative to the shipbuilding industry and the opportunity it represents. We did not find a level of technical knowledge comparable with that of the Tuscan and Liguri coastal regions, and this is expressed in a lack of high level specialization in the area.
6) Assessment of the structure, dimensions and flexibility of the subcontracting companies: the subcontractors are, at times, conditioned by the demands of the shipyards, which have set "limits" to which the smaller subcontractors, in particular, have to conform in the case of a public shipbuilder, but that they do not encounter with the private ones, which are much more flexible.
7) The competition is fierce, and it is therefore more difficult to "impose" a price that, in most cases, will be decided by the shipbuilder.
8) Efficient purchasing may at times result in inefficient production because engineering does not take place only prior to construction, but may change and may have to adapt throughout the entire production process of the vessel. This speaks for the advantage of working closely with the shipbuilder.
9) Critical aspects relative to complex or customized products: these may arise, especially in the details relative to particular product specifications.
10) The lack of space in the ports, particularly at Ancona, is one of the complaints of the operators. Shipyards need two things: space and personnel, leanness, and professional training.
11) On the industrial front, we observed a lack of coordination between the province-municipality-region in relation to the construction of a ship, yacht, or pleasure boat. The shipyard finds itself having to manage the different demands of the three institutions. This implies the need of strategic and coordinated planning by a single body.
12) The necessary experience of the personnel on board.

5. *The subcontracted segments*

Our findings show that, except for activities of "Engineering" and "Purchases", which consist mainly of foreign procurement, it is possible to identify four similar major areas of local or national procurement in which, in turn the main activities involved in the construction of a vessel can be identified and categorized.

Figure 16: The subcontracting system for "boatbuilding" (segmentation).



Source: Author's own elaboration.

The subdivision of economic activities by macro-area, as well as the interviews held with of several privileged witnesses, were essential in identifying the regional enterprises connected with the shipbuilding industry.

6. *Parameters for the selection of suppliers*

Subcontractors are selected through a careful evaluation of parameters that, in the words of the shipyard management, are essential and tend to determine the final choice.
The parameters can be classified in order of importance.

Table 6: Supplier selection parameters.

Parameters	Orders
Quality	1
Delivery time	2
Price	3
Production processes	4
Localization in the region	5
Use of lightweight materials	6
Other: Regulation and contributory regularity	7

Fonte: Author's own elaboration from data interviews.

However, despite the classification in order of importance, it appears that quality and timely delivery are equally important as determinants of the final choice of a subcontractor. Next comes price, which naturally is dependent on the first two and on production processes. Finally, except for

shipbuilders engaged in refitting, for whom the location of the subcontractor in the region is important, for the other companies, it only matters with regard to processes of quality control.

7. *The needs of professional training and relations with research centres*

- Professional training needs

Under the heading of "professions linked to the sea", specific training is involved in a great number of roles: from the merchant marine ship's officer to the maritime expert, passing through the oceanographic research centres and organizations for the protection of the coastal regions (from pollution), monitoring of the maritime and terrestrial environment, all the way to high level experts in the maritime supply chain, port authorities and onboard services, or even teaching degree courses in engineering for the sea (the University of Rome III has an ad hoc course ongoing at this writing).

The educational offering for the "professions of the sea" begins in high school: there are about 50 technical institutions for transportation and logistics, often identified in the old way as nautical institutes. The first, under Gentile, was founded in 1923 and was still in function until 2010, when the Minister of Education Mariastella Gelmini enacted a complete restyling of that course of studies that now is one of 11 different orientations of technical instruction. In addition to the basics of physics, chemistry, information technology and applied sciences, there is particular attention to subjects like mathematics, electric technology, electronics and automation, law and economics, mechanics, and principles of navigation. To initiate the maritime career, it is necessary to attend a nautical institute, be matriculated in the "people of the sea" and successfully complete the course of basic training. With these requisites, graduates can obtain the qualification of deck officer cadet, e.g., oriented toward a position of command, or be assigned to engine room operations, operation of machinery and maintenance of all the mechanical and electrical equipment on board, including the main engine apparatus. It will be possible to start working on merchant vessels and continue the career from there.

After 12 months (approximately 2 years) of navigation as a student deck officer, the student can take the examination for qualification as officer of navigation or of machinery. At this point the career is divided depending on the tonnage of the ships (for officer of navigation) or of the power of the engine apparatus of the ship (for machinery officer) on which the student performs the navigation required for the next qualification. The academic offering has also increased over the years: at the University of Bari, for example, there is a degree course in Sciences and Management of Maritime Activities; at the University of Messina they offer a degree in Sciences and Technologies of Navigation; at the «Parthenope University» (Naples) they specialize in the operation of ocean-going vessels and in nautical, aeronautical and meteorological-oceanographic sciences. Students who graduate from nautical institutes can enrol in all the university departments and various types of technical institutes of higher education (ITS), the Italian merchant marine academy and three other military academies.

Examining the situation of the Marche shipyards, as indicated in the table below (Table 7), the types of professional qualifications engaged in "production sectors" may, for most of the shipyards, be either internal or external resources.

Table 7: Professionals employed in the production area.

Ruolo	***Ris. Interne***	***Ris. Esterne***
Saldatori	x	x
Carpentieri	x	x
Allestitori (tubi per impianti)	x	x
Falegnami	x	x
Elettricisti	x	x
Meccanici	x	x
Arredatori	x	x
Condizionamento	x	x
Ascensori	x	x
Project Manager	x	

Source: Author's own elaboration on interview data.

In specific cases like carpentry, installations, and electric wiring, often the company resort to indirect resources in the form of contract personnel. There is also a sort of personnel specialization denoted by certain geographical origins, for example in sectors like painting, mechanics, and unspecialized labour such as insulation: respectively Bangladesh, Romania (with a long tradition

relative to nautical mechanics) and Africa. At the national level, the Apulia region is a major source of labour for ships' carpenters. In their recruitment of technical personnel, the interviews we made in the Ancona district revealed some critical aspects, though they were not uniformly encountered, but varied depending on the experience of the shipyard. In some cases, and when necessary, the shipyards would contact agencies for temporary employees, or count on collaborations with the local technical schools like the Benelli Technical Institute in Pesaro. In both cases, the collaboration might end with the stipulation of a permanent contract with the worker provided: the internship model alternating school with work fostered valid solutions. The necessary requisites for the worker are flexibility, manual dexterity and knowledge of English. This latter is strategic and fundamental in view of the increasing culture of the nautical clientele. Most ship owners are foreigners and seem more interested in following the production processes directly and supervising works in the shipyard. Interaction with the workers is therefore critical so that knowledge of English has become essential.

In general, the shipyards complain of specific shortcomings for the naval sector, despite the acknowledged excellences of the region. In particular, there are few artisan firms specialized in luxury carpentry on board, and the need for naval and heavy carpentry forces the shipyards to call in personnel from other areas with a long and consolidated tradition in those sectors. The most reliable companies, including some historically loyal to certain shipyards, are located in Naples, Messina and Savona, where they receive the orders and send out their carpentry personnel (from 8 to 10 specialized craftsmen at a time). For the smaller shipyards, the ability to dock and berth vessels up to 300 ft (2/3,000 tons) is crucial and requires the work of companies with specializations, such as carpentry which, however, often involve personnel trained over the years in heavy carpentry, mainly in northern Italy.

The refitting sector also shows that the major jobs, except for a case in the Pesaro area, are done by specialized personnel from other regions. This, in addition to not contributing anything to the regional economic fabric, also means higher costs for labour, board and lodging, and an increase in the cost of the contract. Moreover, when local resources can be accessed by local shipyards (mainly in welding and carpentry), these are workers that will be hard to replace locally when they retire, as younger workers are rarely interesting in performing these types of activities.

Additional critical points refer to the lack of professionals trained in technical aspects such as nautical engineering and 3D design.

Regarding personnel training, it is therefore essential to offer courses of English targeted on the training of laborers and other personnel employed by the shipyards. This is a step that a number of shipyards have already taken, or are about to, starting in the summer. In view of the need to provide constant updating, additional training will concern the renewal and modernization of all the

professions operating in shipyards. Personnel training is generally provided internally by the shipyard, with the exception of certain aspects such as safety which, in most cases, is provided externally. When recruitment and training are done externally, they imply careful monitoring by the shipyard in terms of verifying the professional skills of the subcontracting personnel. In this connection, the people interviewed reported that the subcontractors who carry out specialized work do so under close supervision. However, certain types of subcontract work can be done in the contractors' own structures, though the final assembly will be done at the shipyard. For logistic reasons and because it may be necessary to make alterations during constructions, as in the case of the installation of furnishings, monitoring and inspection by the shipbuilder is done directly in the warehouse, prior to shipment and subsequent installation on board.

Considering the data collected in the interviews in light of future prospects with regard to training programs and what would be desirable, the following needs became apparent:

1) Training courses specialized in the design and construction of boats and yachts;
2) Training in logistics and order management, including training targeted on creating managerial personnel specialized in nautical engineering. Logistics, for example, should not be considered only in terms of light vessels any longer. There are now pleasure boats ranging from 150-300 ft and 2000-2500 tons (even up to 3800 tons) that require exceptional capacity, currently unavailable, to predict all the stages, from reception to movement, from restructuring to remodelling and returning to the water. As a result, one of the key points seems to be the need to reorganize the timing of the shipyards: long periods like 27-42 months are too much in terms of space and costs that could be employed on other orders;
3) Targeted programs of quality certification for every sector internal to the shipyard: sales and technology first of all, then all the production.

- Relations with Universities and Institutions

As regards relations with the academic world and the universities in the area, the scenario is not particularly satisfying. On the one hand, the industry complains of a lack of integration by the universities, which provide very little activity either in the training sector or in that of research. The sole examples of collaboration seem to be requests from the "quality offices" of the shipyards that contact the universities for particular tests (hardness and tensile strength of materials, quality of welds, etc.) On the other hand, the local enterprises are mainly "business-units" with more practical applications linked to aspects of construction.

However, there are some contacts in the form of collaboration that indicate, as could be gleaned from the interviews, some interest on the part of the shipyards in developing relations further,

both as regards training and also with regard to research applied to aspects relative to the nautical industry. In this connection, the maritime cluster in the district, coordinated with the Polytechnic Institute of the Marche, organizes periodical meetings with businesses in the region's nautical sector, not only to discuss and share different experiences but also to compare notes on plans for study programs, courses of specialization or advanced courses for degree candidates, mainly electrical and hydraulic engineers, which would also contemplate internships directly in the companies.

8. *Problems and Prospects*

While there is no clear deviation on production, a shift toward greater use of carbon seems likely. This would make it possible to lighten the upper part of the vessels and make the lower part heavier, for higher performance and power. A more sustainable alternative would be LNG propulsion systems, using Liquefied Natural Gas, on which much work and investment is concentrating. In terms of leadership in the sector, the challenge for some of the shipyards mentioned has already been won. Among these, it is worth focusing on Fincantieri, the largest European shipbuilder for cruise ships since the worldwide financial crisis ended. Its portfolio is significant, as can be seen from the latest financial statements, and will probably continue along that line for the next several years.

If anything, its challenge is to convert part of its production to higher tonnage, just because the market trend is moving toward oceanic giants. In this connection, naval construction is a closely watched business to the extent that the ships are all built on the basis of international regulations. These are guaranteed by large institutions of certification for naval construction: for Italy there is RINA (Registro Italiano Navale); for France Bureau Veritas, for England Lloyd's Register, for Germania Det Norske Veritas and for the US, The American Bureau of Shipping. Construction is controlled and inspected at every stage, from the stipulation of the contract and start of design to completion of the vessel, when the certificate of class is issued, certifying, and guaranteeing that it is adequate to navigate and built to satisfy all the criteria. In terms of challenge, all this means that the quality is what determines a greater competitive advantage in the international context.

At this point it becomes necessary to observe China's position. The Asian giant has launched a series of industrial policies, like the New Normal, Made in China 2025 and the Belt and Road Initiative – to which it is necessary to respond. China has a population of 1 billion 400 million and, though its GDP is stalled at the moment, with respect to the previous constant rate of +6.7/6.8% annually, the demands of its population continue to grow (Sole24Ore 2019). They spend and they travel, and the percentage of passengers who prefer the cruise experience increases year after year (Sole24Ore 2019). It will be a market to serve, and that implies that gradually, the ships will be built in China. For some shipyards, production in Italy is now at 50% and could soon lose its position as a reference market. This has knock-on effects on local manufacturing, that is no longer "primary" for

the shipyards. On the contrary, the Italian industrial districts have a strong propulsive capacity and are particularly attractive when it comes to investment. There is still a competitive advantage for the carpentry and furnishing sectors. Interior designers for the naval sector in Italy are numerous and important. That is not the case abroad. "Made in Italy" still counts in this sector. Strategically, the Marche region has a sales surplus on the manufacturing side. The monetary value of the nautical industry in Italy corresponds to US$ 2,315 million, which makes this country a super-power in the field of shipbuilding (UCINA 2019). Even the trends are positive: an improvement of +10.4% is expected in shipbuilding and +7.8% in the sector of fittings and accessories. Another positive sign is that 63% of the entrepreneurs confirm this expectation of growth.

It is therefore essential to draw a clear outline of the industrial policy at a time of strong expansion, when it needs to be able, on the one hand, to perform increasingly difficult processes from the technological standpoint, with a shrinking workforce, on the other. There has been a move toward automation by many companies, but they must succeed in building integrated networks from the design of the materials to the organization and response to new demands. As we have seen, the shipbuilding sector has grown increasingly complex, and it is also essential to bring innovation into the exchange of research within the network. The very concept of "Made in Italy" implies an industrial policy which considers it necessary for artisans to produce in more innovative ways than their competitors. It would not be healthy to focus on developing a single subcontracting supply chain; it is essential and strategic to facilitate the inclusion of the largest possible number of related businesses in the district.

9. *Prospects for the supplier*

This section of the study will focus on the subcontracting sector of supply to the nautical industry in the Marche region during a time of expansion. The two main research questions are:

1) How should the subcontract supply chain be developed and increased in the long term?
2) What actions should be implemented to respond to the growing demand for qualified personnel both for specialized and technical positions and for management?

The methodological approach used here in the framework of qualitative research explores the situation as regards surveys carried out in the Marche districts. The study involved a sampling of companies based in the Marche, as well as a few privileged witnesses. The section contains a summary of results reported in interviews with subcontractors.

10. *The sample*

The sample to which this study refers consists of 16 enterprises (Cantori, CPN, Cromia, Elettromedia, Fratubi, Furlanetto, Giorgio Niccolini, IGI Allestimenti, IMAR, Mino e Grazia,

Roccheggiani, Studio Massari, Suretè, Tende Tendenze, Videoworks, Vitrifrigo) which operate on various levels in the sector of nautical construction. They were asked to respond to a questionnaire (annexed). The sample consists of companies with different characteristics both in terms of their activity and their size, as well as the type of production. The main activities of these companies can be grouped into the following categories:

1) Services linked to the shipyard (erection of scaffoldings, cleaning services, guard service);
2) Installations and Hi-Tech (electrical systems, plumbing and air treatment, navigation and communications systems, audio, video, technological systems and domotics);
3) Processes (hull construction, painting, welding);
4) Fitting (carpentry, cabinetry, furnishing and decoration).

The size of the companies in the sample varies depending on the characteristics of the company, from individual companies to joint stock corporations; also depending on the number of employees, from micro-enterprises with fewer than ten employees to moderate-sized companies with more than 250 employees. With regard to the type of production, the companies differ between those that make custom products and those that manufacture mass produced goods.

11. *Reference market*

The first aspect analysed concerns the study of the main segments of the market in which the subcontractors operate. We have observed how most of the companies interviewed work mainly with production companies and, secondarily, for the private sector. The reference market is mainly Italian and primarily regional, however some of the companies interviewed extend their offering abroad (Europe, the US and Canada). None of the companies studied expects a decrease in business, at least for the next 3 years, at most they expect it to remain stable. Indeed, the majority expect that the market will grow. Many of them have orders until 2022.

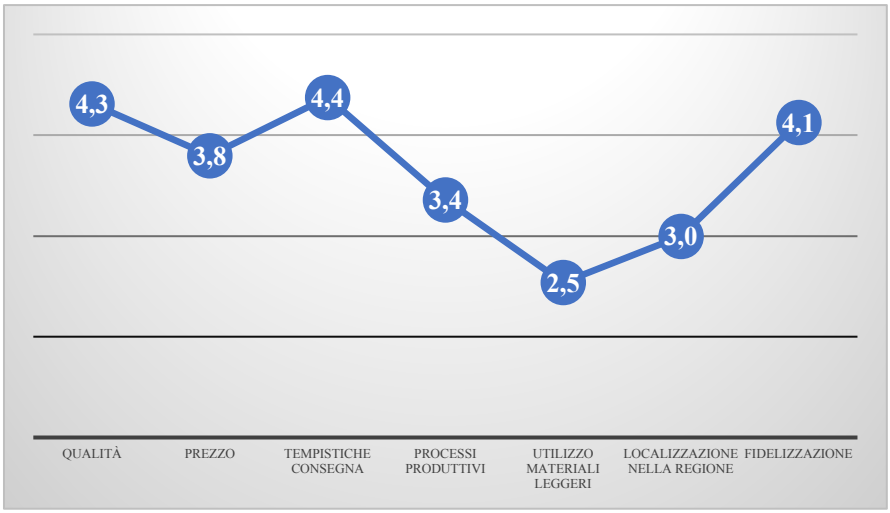
12. *The potential of nautical construction as an expanding market*

Shipyards were asked to indicate which critical aspects should be improved in the relationship with subcontractors. Delivery timing and lack of planning seem to be the most critical areas and aspects needing improvement. For the subcontractors it was excessive bureaucracy, difficulty contacting purchasing departments and the issue of competition relying on maximum price reduction. Another aspect reported concerns the competitive advantage that the companies interviewed feel they can offer their clientele. Flexibility, quality, customization, and respect of delivery timing are the main factors that the companies identify as their competitive advantage. Those companies that have always operated exclusively in the shipbuilding sector consider this a significant competitive advantage for the clientele.

Regarding the prospects of the naval shipyard sector, it should be noted that companies operating exclusively or primarily in this sector have a high probability of developing their business further. On the contrary, companies that operate on a small scale – and not by strategic choice – with naval shipyards, or that do not have an opinion on the subject, consider prospects limited. A random sampling of companies was asked to indicate whether they are aware of limits and barriers to entry for them to work with the shipyards. Most believe there are, or have been, limits and barriers to be overcome, on one hand because the sector is highly specialized, and on the other, because it is not easy for the companies to contact the purchasing departments of the shipyards. The companies that have been working for years in the shipbuilding sector face very different prospects than those that are trying to enter the sector now. The former have long-standing relations with the shipyards and plenty of orders. Sometimes, to satisfy the demand, they are forced to rely on other suppliers. Some companies that do not work exclusively for the shipyards say they are very careful to evaluate the percentage of their turnover that they were to devote to the sector, so as not to unbalance their business too much and risk, in case of a drop in the market, finding themselves in difficulty. The latter complain that they find it difficult to establish a relationship with the shipyards, that often already have privileged relations with certain subcontractors and because competition relies heavily on who can offer the lowest price.

We asked the sampling which of the following parameters are most significant in the selection made by the naval shipyards: quality, price, delivery time, production processes, use of lightweight materials, location in the region, loyalty, other. As indicated in the graph below (Figure 17), for the companies interviewed, the parameters for selection of their subcontractors are related mainly to three factors: delivery time, quality, and loyalty.

Figure 17: Selection parameters by shipyards.



Fonte: Author's own elaboration on data from interview.

Many stressed how experience in the specific sector of production is a fundamental parameter. The local base of the supplier in the region is important for those companies that require custom work and that call on the subcontractor toward the end of the production cycle (as in the case of decorators). On the contrary, for companies that supply mass produced elements, location in the region is either irrelevant or penalizing because they are distant from the many processing centers (large shipyards and clients).

13. *The needs of professional training and relations with research centers*

- Professional qualifications

Part of the questionnaire is devoted to professional qualifications. Building on Heart (2008), we wanted to understand, on the one hand, what sorts of professional qualifications are employed in the production sector and whether they are internal or external and, on the other, what sort of professional figures companies want on their staff. As regards the critical issue of recruiting technical personnel, the companies interviewed reported increasing difficulty in finding specialized personnel who are willing to work far from home. The forms of recruitment employed by the companies are of various kinds: technical schools, recruitment websites, employment agencies, LinkedIn, "work with us" section in the company website.

An interesting statistic emerges from the analysis of the responses to the question regarding the types of procedure the companies apply for training their personnel. Most train their own personnel by flanking the new employee with a tutor, a person with experience who can transfer his knowledge. In addition to this method, companies train their personnel with specific courses. The artisan businesses in the sample, particularly those that operate in the sectors of furnishing and decorating, would be willing to support training courses capable of transferring their skills to young people interested in learning a trade.

- Relations with Universities and research Institutions

Another aspect investigated concerns the relationship that subcontractors may have with the universities and the world of research. Half the sample interviewed declared that they had no contacts with the higher education and research, though they expressed great interest in such interaction. More structured collaborations have been established by those companies that have been operating exclusively in the sector for a long time, for example, through partnerships with foreign universities and the implementation of internships.

14. *Prospects*

The companies in the sample were asked which segments need to be valorised or supported in the future to consolidate and encourage growth in the shipbuilding sector. Know-how, craftsmanship, design, and Italian creativity are the factors that according to the companies interviewed should be valorised/supported.

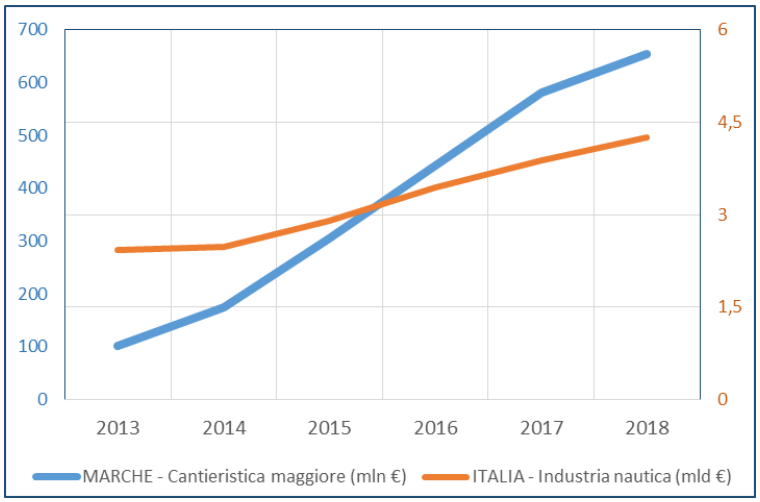
4.5.2 *Considerations*

- *A Healthy System*

The nautical industry in the Marche region has experienced a period of major upheaval and is now evolving in a highly positive way, confirming a strong tendency toward the customization of products and services, on which the most basic organizational and production processes are changing in coherent and logical ways. The shipyards tend more and more to coordinate pools of outside companies and operators; the increasing complexity of the solutions demanded creates difficulty for the owners to find the materials and parts they need, while holding them to higher quality standards. On the other hand, the rise of an increasingly knowledgeable and "creative" class of subcontractors, under the control of specialized companies that guarantee quality and reliability of production timing, customization and detail, maintenance and service, is the key to the success of the new nautical industry for the Marche Region.

The products of the local shipyards are highly valued abroad, where the competition requires the supply chain to adapt in terms of the increasing skill and quality of the staff. The recovery of business that has characterized the Marche's industry is not expressed so much in processes of selection as in the overall growth trend of the supply chain, such that almost all the companies have been able to take advantage of this new stage of growth.

Figure 18: Intensity of turnover evolution (v.a. 2013-2018).

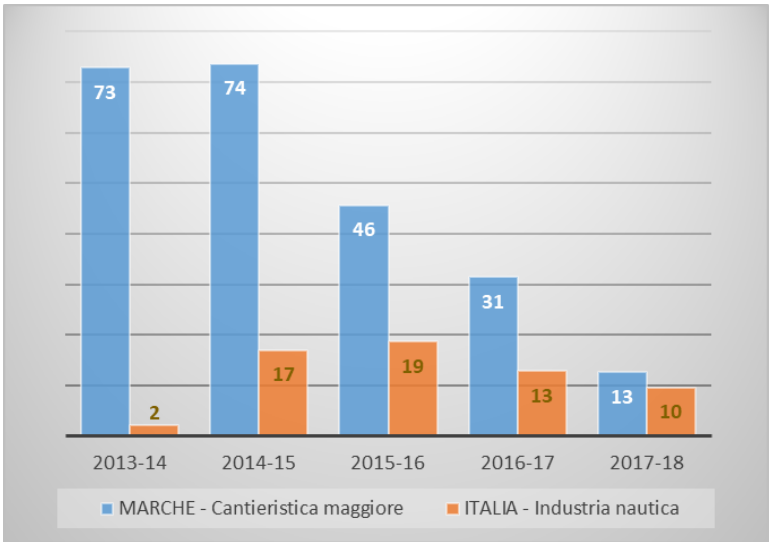


Source: Author's own elaboration on data from UCINA 2019.

Looking at the last few years, a period of strong recovery of the entire nautical sector (see Figure 1), the dynamics of turnover for the main nautical shipyards of the Marche region (estimated on the basis of the cumulative sales of the companies interviewed) reveal strong growth leading to total turnover in 2018 up to 6 times greater than that of 2013 (see Figure 18). A comparison with the entire Italian nautical industry clearly illustrates the intensity of the growth of the largest shipyards in the Marche region, which reported average annual growth rates of +39.5%, compared to +9.5% for the nautical industry in Italy as a whole. An additional perspective becomes clear if we observe the dimensions of the growth each year with respect to the previous year. If it is physiological that rapid growth rates are physiologically destined to decrease their incidence, year by year over time, the dynamic revealed by the following figure shows a trend of narrowing of the averages for the sector due, probably, to the structural limits that the context places on steady growth of the sector.

The "ecosystem" clearly has not attained its full development and risks conditioning the performance of the sector unless investments are made in adequate infrastructures, know-how and a "nautical culture" which, as we shall see, are essential elements to enable the continued growth of the industry in the Marche region.

Figure 19: Rate of change in annual turnover (val.%, 2013-2018).



Source: Author's own elaboration on inteview data and UCINA Confindustria Nautica, "La nautica in cifre. Monitor 2019", 2019.

The system is rife with obstacles: the smaller businesses in the sector, those that produce small boats or engage in service operations like refitting, for example, often find themselves tied up in short-term contracts, sometimes far from the base of operations, but the ability to meet the needs of the most demanding corporate executives, even abroad, is strategic for them to have success in this sector. 2018 was a good year, and the underlying trend is upward, however there is a widespread feeling of uncertainty that has generated a prudent attitude toward prospects for the medium and long term.

But notwithstanding the current economic conditions, a series of factors continues to hinder growth, and the most serious of these is the difficulty in recruiting qualified, motivated personnel.

- *The Future in Refitting*

  Two interesting issues needing further consideration emerged from our interviews:

1) 75-80% of non-professional supply comes from outside the region (the most highly qualified craftsmanship is found mainly in Germany and Austria);
2) the shipyards are growing increasingly interested in the refitting market.

The global refitting market, in perspective, appears to be a large and promising business. Maintenance of pleasure craft is a stable market that does not appear to be influenced by macroeconomic issues, unlike the boat purchase. In maintenance, the vicinity of the supplier and access of the boatyard to the sea are crucial factors. Since it is to be expected that the challenge will move toward refitting larger boats, it will be essential to undertake some strategic programming targeted on integrating and coordinating the many small businesses in the industry. In that sense, numerous benefits could derive from a strong synergy between public and private in terms of:

- increasing levels of employment;
- integration with actions in the tourist sector;
- implementation and use of new technologies;
- development of opportunities for the launch of new businesses fostering the subcontracting system.

Considering the excellence of manufacturing demonstrated by the region's enterprises, an ideal strategy would seem to be the formation of a "nautical cluster" focused on actions of economic development within the Marche ecosystem. The development of synergisms between public administrations, businesses and research facilities would certainly feed a virtuous cycle for effective management of the resources and the creation of a shared vision.

- *Manufacturing and the Shipyard Supply Chain in the Marche Region*

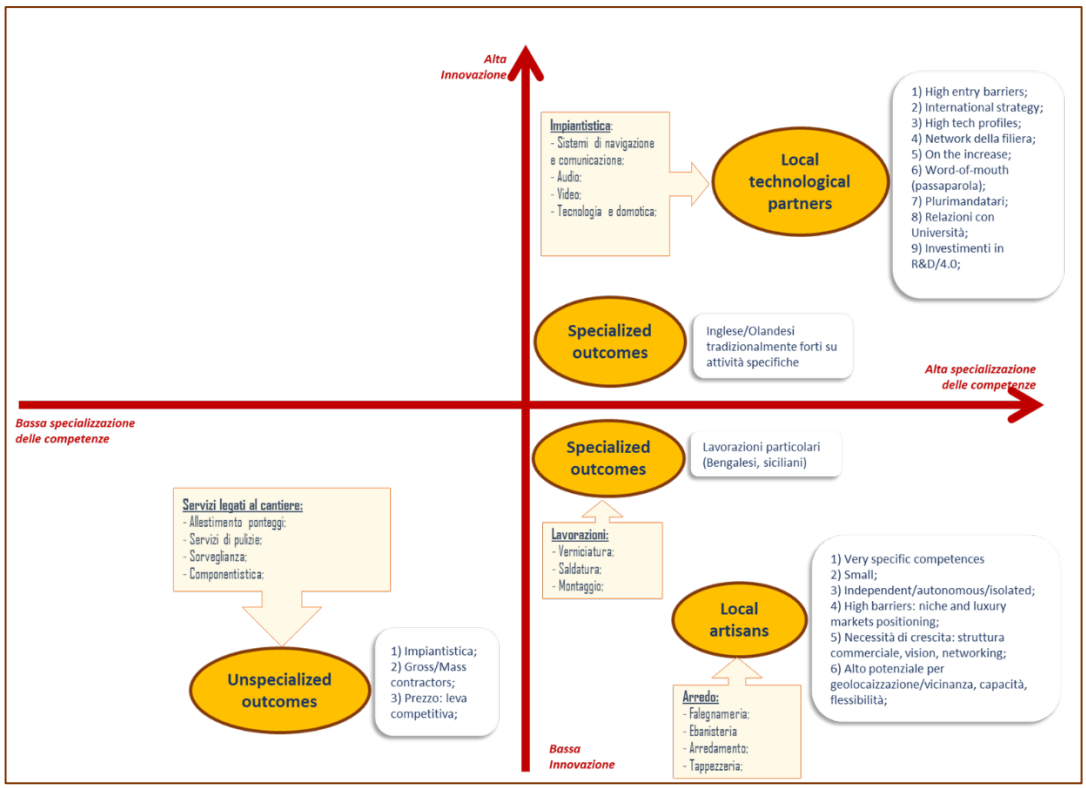
As already noted, the main players operating in the nautical industry of interest in this study are the naval shipyards on the one hand, and the suppliers of products, services and processes on the other. The shipyards are divided between large and medium/small, on the basis of the size and type of production:

- the large shipyards build ships and mega-yachts, and are often able to operate independently and with strategic-productive and commercial logics divorced from the territory in which they are located (logics of procurement, networks of subcontractors, recruitment and management of the workforce);

- the medium and small shipyards produce craft of moderate size, and some are mainly engaged in refitting and maintenance.

From the interviews, it could be seen that both would like to have greater involvement with local suppliers and would be interested in establishing long-term, fiduciary relationships at the local level. Regarding suppliers, it is possible to summarize their characteristics in Figure 20, which traces their positioning on the basis of the content of specialization involved in their skills (high/low) and levels of innovation (high/low).

Figure 20: Suppliers by skill specialization and innovation content.



Source: Author's own elaboration.

In the diagram, we can distinguish:

- Non-specialized suppliers "Basic Outfitters": assigned to simple, labour-intensive tasks with a high intensity of physical effort and low value added: cleaning, unloading, assembly, suppliers of labour recruited externally.
- "Specialized Outfitters": for processing of lathing, welding, painting, outfitting the line, shipping, which require skills at a low professional level but with specific requisites (precision finishing trades). These processes are generally assigned to laborers from other Italian regions (Naples and Sicily for carpentry) and/or foreign countries (eastern Croatia, Romania, Bangladesh for painting), traditionally strong in specific trades (England and Holland). These

resources have little or no training, but this is not a barrier to employment. The competitive factors for accessing the network of subcontracting for shipyards are the cost of labour and adaptability to harsh working conditions.

- Local Artisans: they are suppliers of products and services, often artisanal workers and respected producers of manufactured goods, and are selected on the basis of skill and the use of high-quality materials, reliability of craftsmanship and precision workmanship, customization and adaptability to the demands of the clientele. They should be familiar with other trades, even in different sectors, and able to provide valuable advice. Location in the vicinity so as to be available for post-sales service is an advantage. The strong points of these suppliers are a strong work ethic, high productivity, and flexibility. Weak points are individualism, lack of a second line and generational continuity (if small), difficulty of interacting and bonding within networks with other producers (lack of entrepreneurship). This segment of nautical supply is perhaps one of the most promising in terms of growth and potential for the uniqueness of the processes that could position them in niches of high value added (luxury).
- Technological Partners: They are suppliers of turnkey systems and solutions, and equipment with a high technological content, often connected to university centres of excellence (R&D) and in advanced networks with regard to innovation and engineering. These are suppliers whose core business in related or even different sectors is well positioned and significant for the importance of their applications and products in a range of different sectors (air conditioning and air treatment, refrigeration, IT, sensors, electronic equipment, and devices).

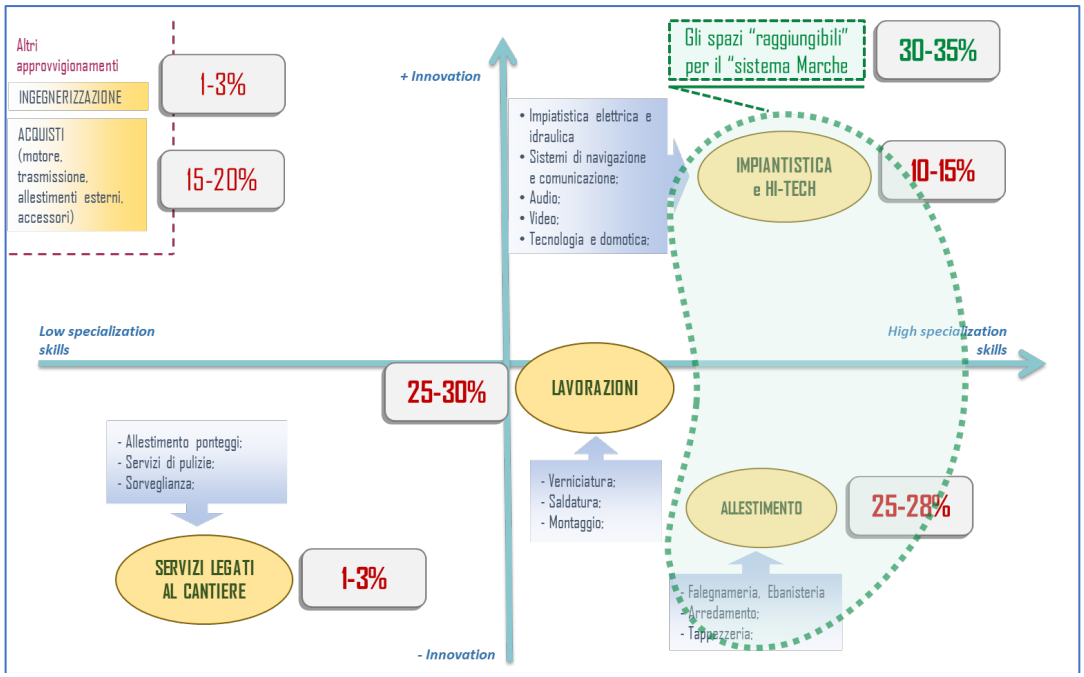
Based on these considerations, with the support of interviews and privileged reports on the sector, we were able to identify the main segments in which it is possible to structure the supply chain of procurement for the Marche's nautical industry and estimate its incidence on the value of purchases by the sector (Figure 21). In addition to the purchase of "products for transmission" (such as the engine) and "fittings for the exterior", for a total value which can be estimated as approximately 1/5 of the total purchase (often purchased outside the national borders, on which the levels and standards of productive specialization do not leave much margin for discretionality in the decisions to purchase), the supplies fall into four categories:

- "processes" (the "specialized outfitters" of the previous segmentation) account for the most important portion of the purchases (about a third of the total);
- the second most important is the category of "fittings" (value equal to at least a quarter of the total), coinciding to a large extent with the "local artisan" segment and often referable to the

main sectors of traditional quality manufacture in the Marche region (carpentry, furnishing and decoration, etc.);

- almost a 1/5 of purchases refer to the "systems and hi-tech" segment where, alongside the "standardized" supply of services of installation or assembly of systems, there are niche businesses connected with the most advanced levels of technological evolution, specialization and innovative capacity (advanced domotics systems, for example);
- the last segment, with marginal incidence, concerns the "shipyard support services" like cleaning and guard service, for which proximity is a crucial element, and scaffolding rental services, for which specific experience in the sector is more important.

Figure 21: The subcontracting chain in the Marche Region's shipbuilding industry (segmentation and incidence on total purchases).



Source: Author's elaboration on data interview.

To respond to the main query of the study (what impact can the positive performance of the shipbuilding sector have on the regional industrial system?), the breakdown of the main subcontractors described above suggests a series of significant considerations. Considering the strong and weak points of each category examined, and exploring the aspects of production included in them, the most promising growth prospects for the Marche's economic system appear to be the "fitting" and "systems and hi-tech" segments. For the "fitting" segment (carpentry, cabinetry, furnishing and decoration) there are important growth margins, considering that the companies operating in these sectors product quality products recognized as such by their clients. The same considerations also apply for the "systems and hi-tech" segment (electrical and hydraulic systems, systems of navigation and communication, audio, video, technology and domotics). It is therefore reasonable to expect a

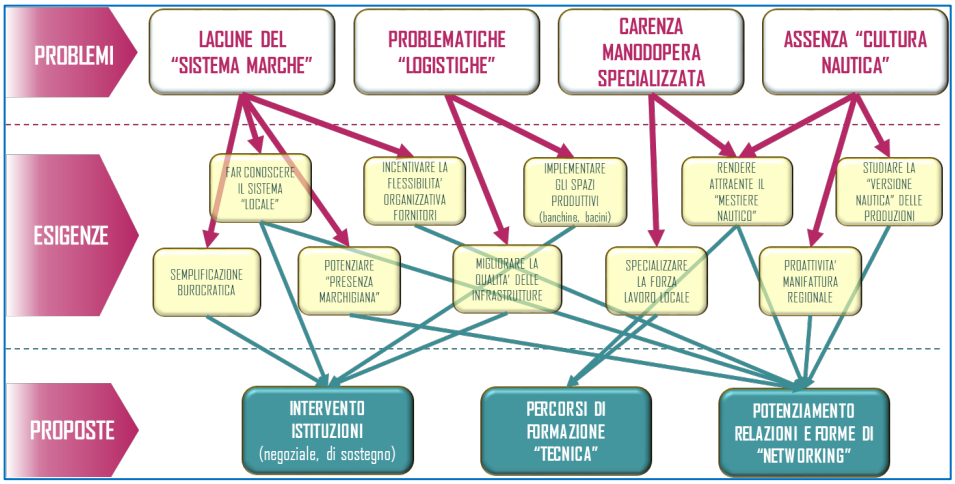
development of the local manufacturing companies of quality, driven by the positive performance of the "shipbuilding system": with particular reference to the sectors just mentioned, the available space could cover up to a third of the resources employed by the shipyards in procurement and supplies. For that to happen, however, in would be necessary for the shipyards to maintain the positive trend and also for them to focus their purchases of goods and services more toward local enterprises, on a path the removes limits and obstacles, facilitating the expansion of profitable business relations.

With regard to the second query of the study (what actions are needed to respond to the growing demand for qualified personnel, for both specialized and technical professions as well as managerial positions?), case studies made of business in the Marche region seem to highlight a problem in the recruitment of personnel for these highly qualified professional positions. Relations with the educational system and universities exist but are insufficient. It is particularly interesting to note that the artisan businesses in the sample, especially those that operate in the sectors of furnishing and decorating, would be willing to support training courses capable of transferring their skills to young people interested in learning a trade.

- ***Obvious Problems and Needs***

From the field survey we made with interviews of operators in the supply chain, some of the difficulties and problems that the "nautical industry of the Marche region" is facing became clear.

Figure 22: The future of the shipbuilding industry in the Marche region (problems, needs, proposals).



Source: Author's elaboration on data interview.

With reference to the four main business categories, it was either clearly stated or could be surmised from the content of the interviews that these difficulties are the result of a series of requisites from which initiatives and strategic guidelines can take their cue.

We isolated three main "potential drivers" in support of the overall development of the sector and supply chain, which can all be reduced substantially to:

- identification of an active role of the institutions;

- acquisition of awareness about the specific training needed;
- strengthening of relations within the supply chain network.

The three drivers are, as we will specify more in detail in the next Section, the logical response of the demand expressed by the businesses, suggesting initiatives and orientations for an effective development and promotion strategy.

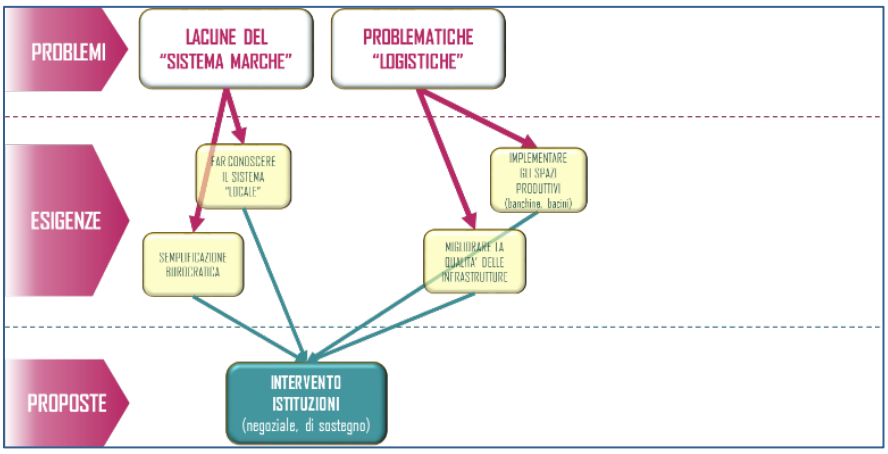
4.6 *Conclusions*

Overall, the shipbuilding industry in the Marche Region has positive impacts on the regional industrial system. However, the results of the survey and the insights provided by the interviews, suggests three main "potential drivers" for policy-making to further develop the sector, considered as a catalyser for the optimization of the regional supply chain.

- *Pathway no. 1: Intervention of the institution*

To maintain the health of the shipbuilding sector, as well as for the dynamics of the global market, some action is required on the part of the institutions to create a favourable "ecosystem" involving them in support of the consolidation and development of competitiveness. Beyond direct action to fill the gaps in the local system (shortcomings of the local infrastructures, complication of bureaucratic procedures, etc.), a more active role would move in the direction of facilitating "procurement in the region" through a facilitated and more extensive use of infrastructures and production facilities. Recovery of the experience conceived, but never implemented, of the "District of the Sea": the institutions could lay the groundwork for the creation of a sort of "regional identity trademark" for which the public and private sector could work jointly, acting to foster technological innovation, welcoming and generating process and product innovation as drivers to establish an independent regional identity.

Figure 23: Intervention of the institutions.



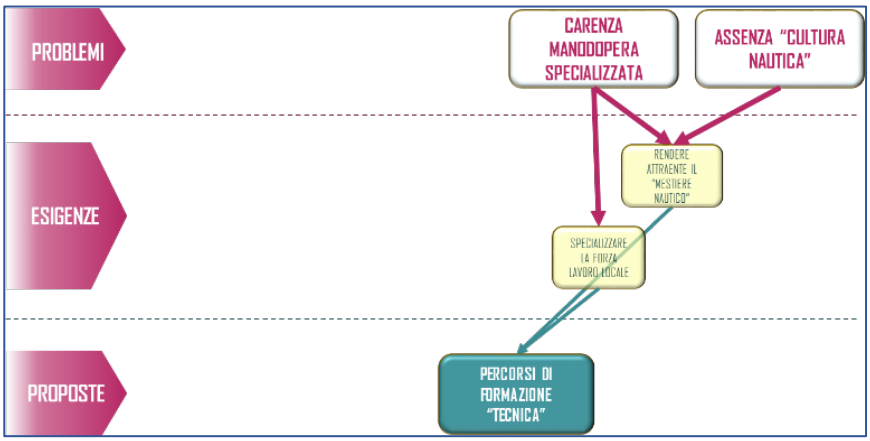
Source: Author's elaboration on data interview.

- *Pathway no. 2: Technical training courses*

A second pathway concerns the training of technical professionals who are able to satisfy the demands that come from the naval construction sector. On the one hand, there is a need to recognize these demands with the resources made available by the public educations system (technical industrial and nautical schools) and private schools; on the other, there is the need to provide the types of courses necessary to train the professional skills that are most in demand in the sector, also by making them

more attractive to the young generations. In particular in the "fitting" segment (carpentry, cabinetry, furnishing and decoration) it is possible to act to avoid what used to happen for the processing segment (painting, welding, disassembly) where many professional skills were lost and now have to be delegated almost exclusively to foreign workers. For this reason, in addition to programming a public training program coherent with those needs, it could be useful to establish a public-private "academy" that, with the support of the public stakeholder, could also directly involve the enterprises (shipyards and subcontractors).

Figure 24: Technical training courses.



Source: Author's elaboration on data interview.

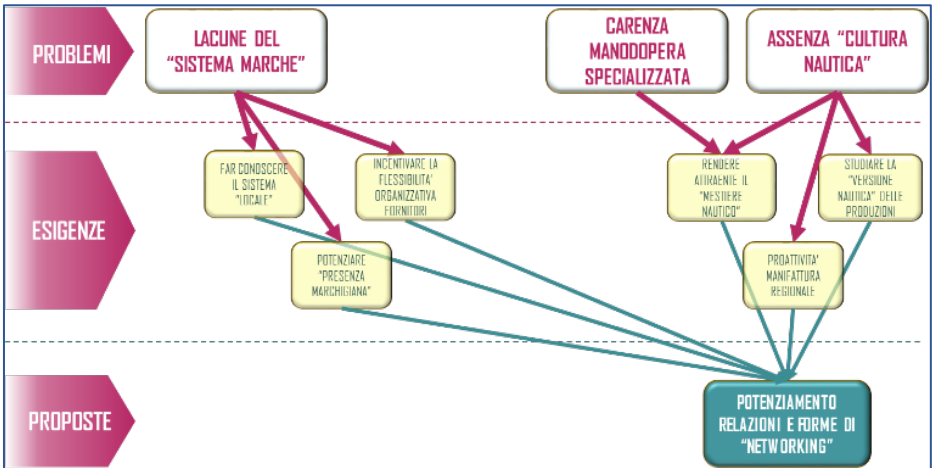
- *Pathway no. 3: Strengthening relations and forms of networking*

The third pathway intends to respond to the current distance between the shipyards and the potential local suppliers in the Marche region: it has been estimated that only about 10% of the total purchases of the large shipyards are made from suppliers operating in the region. If the shipyards say they are unaware of opportunities available to them in the Marche's own manufacturing system, it is also true that the businesses are not sufficiently assertive in offering themselves as suppliers or in adapting their products to "nautical use". In that sense, it is important to strengthen relations and forms of networking between the different players in the naval shipbuilding sector. This goal can be achieved:

- by facilitating meetings, workshops, and other contact opportunities. The local business associations could play an important role in organizing these. This action should, on the one hand, create a more open community and greater sharing of information about what is being done in the nautical sector; on the other, it could try to involve new entrepreneurs who, though not working directly with the shipyards, could gain entry by offering "nautical" versions of their products.

- by creating a "regional catalogue of specialized suppliers" listing the top suppliers in the Marche region, and establishing a dedicated cluster, consortium, or network, which could be either formal or informal.

Figure 25: Strengthening relations and forms of networking.



Source: Author's elaboration on data interview.

The suggested policies and actions are summarized in Table 9.

Table 9: Suggested policies and actions for the development of the sector and optimization of the supply chain.

Ideal pathways for development of the sector and optimization of the supply chain	
Intervention of the Institutions	• Direct interventions to support sectors or supply chains (innovation, competitiveness, enterprise 4.0) • Improvement of the usability of port areas and mobility infrastructures • Concession of space necessary for production extensions (simplification of procedures) • Negotiation shipyards/institutions aimed at encouraging an enhancement of "Marche" supply relations • Promotion of the entire nautical industry from a "district perspective" • Establishment of moments of connection (events, control room, ...)
Technical Training Courses	• Matching the specialized professional needs of shipyards with the resources of the public (industrial and technical-nautical institutes) and private training system • Promote an increase in the attractiveness of the most sought-after professional figures to young people • Create training courses dedicated to specialist skills (in particular, painters, carpenters and welders), which are currently entrusted almost exclusively to foreign workers • Set up a public-private "academy" (its?) that, with the support of public resources, also sees the direct involvement of businesses (Shipyards and Subcontractors)

Strengthening relations and forms of networking	• Role of trade associations (meeting moments, workshops, activation of contacts, ...): o Inform about the potential of the shipbuilding industry o Encourage companies to propose products/services and study "nautical" versions of products • Promote a "regional register of specialized suppliers" for the entire shipbuilding industry, transversal (available to all companies) • Identify and establish transversal forms of networking between companies (dedicated cluster, consortium, informal or formalized network, ...): o Comparison and enhancement of specialized skills o Optimization of the negotiation power (possible economies) o Verification and qualification of the suppliers in "net" o Flexibility in the management of the order o Possible loyalty of the supply chain Path towards a "regional quality brand"

Source: Author's elaboration on data interview.

ANNEX 1 – Statistical Annex

MARCHE - Addetti nelle imprese attive

2015 I trimestre	AN	AP	FM	MC	PU	MARCHE
301 costruzione di navi e imbarcazioni (generico)	4	61	0	44	11	120
3011 *costruzione di navi e di strutture galleggianti*	737	78	1	24	284	1124
3012 *costruzione di imbarcazioni da diporto e sportive*	463	10	16	23	460	972
Totale produzione	**1.204**	**149**	**17**	**91**	**755**	**2.216**
3315 riparaz. e manutenz. navi comm. e imbarcazioni diporto	217	9	4	21	109	360
466911 commercio all'ingrosso imbarcazioni	2	1			1	4
47642 commercio al dettaglio natanti e accessori	40	6	2		21	69
772102 noleggio senza equipaggio imbarcazioni da diporto	1	2	0	1	6	10
Totale servizi	**260**	**18**	**6**	**22**	**137**	**443**
totale produzione e servizi	1.464	167	23	113	892	2.659

2019 I trimestre	AN	AP	FM	MC	PU	MARCHE
301 costruzione di navi e imbarcazioni (generico)	36	0	0	13	58	107
3011 *costruzione di navi e di strutture galleggianti*	900	59	2	25	273	1259
3012 *costruzione di imbarcazioni da diporto e sportive*	506	12	18	16	823	1375
Totale produzione	**1.442**	**71**	**20**	**54**	**1154**	**2.741**
3315 riparaz. e manutenz. navi comm. e imbarcazioni diporto	904	5	5	29	286	1.229
466911 commercio all'ingrosso imbarcazioni	2	1	0	0	0	3
47642 commercio al dettaglio natanti e accessori	47	4	1	0	20	72
772102 noleggio senza equipaggio imbarcazioni da diporto	2	0	1	2	8	13
Totale servizi	**955**	**10**	**7**	**31**	**314**	**1.317**
totale produzione e servizi	2.397	81	27	85	1.468	4.058

Source: Author's own elaboration on data from Infocamere.

var.ass.	AN	AP	FM	MC	PU	MARCHE
301 costruzione di navi e imbarcazioni (generico)	32	-61	0	-31	47	-13
3011 *costruzione di navi e di strutture galleggianti*	163	-19	1	1	-11	135
3012 *costruzione di imbarcazioni da diporto e sportive*	43	2	2	-7	363	403
Totale produzione	**238**	**-78**	**3**	**-37**	**399**	**525**
3315 riparaz. e manutenz. navi comm. e imbarcazioni diporto	687	-4	1	8	177	869
466911 commercio all'ingrosso imbarcazioni	0	0	0	0	-1	-1
47642 commercio al dettaglio natanti e accessori	7	-2	-1	0	-1	3
772102 noleggio senza equipaggio imbarcazioni da diporto	1	-2	1	1	2	3
Totale servizi	**695**	**-8**	**1**	**9**	**177**	**874**
totale produzione e servizi	933	-86	4	-28	576	1.399

var.ass.	AN	AP	FM	MC	PU	MARCHE
301 costruzione di navi e imbarcazioni (generico)	800,0	-100,0	#DIV/0!	-70,5	427,3	-10,8
3011 *costruzione di navi e di strutture galleggianti*	22,1	-24,4	100,0	4,2	-3,9	12,0
3012 *costruzione di imbarcazioni da diporto e sportive*	9,3	20,0	12,5	-30,4	78,9	41,5
Totale produzione	**19,8**	**-52,3**	**17,6**	**-40,7**	**52,8**	**23,7**
3315 riparaz. e manutenz. navi comm. e imbarcazioni diporto	316,6	-44,4	25,0	38,1	162,4	241,4
466911 commercio all'ingrosso imbarcazioni	0,0	0,0	-	-	-100,0	-25,0
47642 commercio al dettaglio natanti e accessori	17,5	-33,3	-50,0	-	-4,8	4,3
772102 noleggio senza equipaggio imbarcazioni da diporto	100,0	-100,0	-	100,0	33,3	30,0
Totale servizi	**267,3**	**-44,4**	**16,7**	**40,9**	**129,2**	**197,3**
totale produzione e servizi	63,7	-51,5	17,4	-24,8	64,6	52,6

Source: Author's own elaboration on data from Infocamere.

MARCHE - lavoratori per dimensione aziendale - totale nautica di produzione - 2017

TERRITORIO	Da 1 a 9 lavoratori	Da 10 a 49 lavoratori	Da 50 a 249 lavoratori	Totale
PU	207	631	239	1077
AN	102	258	299	659
MC	31	15	0	46
AP	29	47	0	76
FM	13	16	0	29
MARCHE	382	967	538	1887

Source: Author's own elaboration on data from INAIL.

MARCHE - lavoratori per dimensione aziendale - costruzione di navi e di strutture galleggianti (3011) - 2017

TERRITORIO	Da 1 a 9 lavoratori	Da 10 a 49 lavoratori	Da 50 a 249 lavoratori	Totale
PU	57	209	71	337
AN	46	173	299	518
MC	26	15	0	41
AP	22	47	0	69
FM	5	0	0	5

Source: Author's own elaboration on data from INAIL.

MARCHE - lavoratori per dimensione aziendale – costruz.e di imbarcazioni da diporto e sportive (3012) - 2017

TERRITORIO	Da 1 a 9 lavoratori	Da 10 a 49 lavoratori	Da 50 a 249 lavoratori	Totale
PU	108	322	168	598
AN	24	64	0	88
MC	5	0	0	5
AP	2	0	0	2
FM	8	16	0	24
MARCHE	147	402	168	717

Source: Author's own elaboration on data from INAIL.

MARCHE - lavoratori per dimensione - riparazione e manutenz. navi e imbarcazioni (esclusi i loro motori) - 2017

TERRITORIO	Da 1 a 9 lavoratori	Da 10 a 49 lavoratori	Da 50 a 249 lavoratori	Totale
PU	51	46	0	97
AN	31	41	154	226
MC	21	0	0	21
AP	4	0	0	4
FM	5	0	0	5
MARCHE	112	87	154	353

Source: Author's own elaboration on data from INAIL.

ANNEX 2 - Schedule of interviews with shipyards

ISTAO ISTITUTO ADRIANO OLIVETTI

FONDAZIONE MARCHE

Survey **"La cantieristica navale nella regione Marche"**

Topic: Industria nautica

Obiettivo: Esplorare a fondo la performance del settore della cantieristica navale delle Marche, individuato come settore di traino per lo sviluppo della subfornitura artigianale, qualificata e tecnologica di supporto. In particolare, i dati e le informazioni raccolti attraverso la survey in termini di posizionamento e andamento, di opportunità e criticità nel far fronte alle esigenze di mercato, saranno oggetto di analisi per comporre un quadro degli elementi distintivi del settore, delle necessità e delle sfide da cogliere. Quanto alle capacità e competenze da sviluppare, si identificheranno le tipologie di subfornitura e le filiere strategicamente opportune per lo sviluppo economico regionale.

Focus: Filiere della subfornitura e quadro della qualificazione professionale.

Sezioni:

SEZIONE 1: L'IMPRESA
Le risposte ai quesiti di questa sezione è mirata a definire:
⇒ *la storia e le caratteristiche del cantiere, struttura attuale e produzione;*
⇒ *la dimensione e le caratteristiche del mercato di riferimento del cantiere;*
⇒ *il grado di tecnologia e innovazione del cantiere in relazione alle sfide della contemporaneità;*
⇒ *i rapporti con università e istituti di ricerca al fine di valutare il ruolo della ricerca all'interno della rete e nell'identificazione di best practices, nuove soluzioni e potenziali percorsi condivisi di sviluppo;*

SEZIONE 2: LA FILIERA
La sequenza di quesiti è centrale ai fini dell'analisi ed è mirata a:
⇒ *ricostruire l'indotto del settore al fine di analizzare la complessità dell'industria cantieristica;*
⇒ *identificare gli attori che compongono l'offerta di subfornitura così da definire le principali peculiarità;*
⇒ *esaminare le criticità riscontrate nella fase gestionale in relazione alle future esigenze di mercato;*
⇒ *individuare le filiere della subfornitura di interesse in una prospettiva medio/lungo termine;*
⇒ *identificare e analizzare le peculiarità della formazione professionale in termini di competenze e skill richieste:*

SEZIONE 3: LE PROSPETTIVE
La sequenza di quesiti è mirata a:
⇒ *Individuare vincoli e opportunità nell'attuale modello di governance del settore al fine di riflettere su una potenziale programmazione strategica (0-10 anni);*
⇒ *Identificare le sfide e le opportunità di sviluppo attraverso la ricerca di soluzioni innovative e sostenibili;*

ANNEX 3 - Questionnaire submitted to subcontractors

ISTAO ISTITUTO ADRIANO OLIVETTI

FONDAZIONE MARCHE

"La cantieristica navale nella regione Marche"

QUESTIONARIO SUBFORNITURA

1. AZIENDA

Regione sociale: .....
Sede .....
Descrizione attività: .....

1.1. Tipologia dell'impresa:
Ditta Artigiana ☐ Si ☐ No
Forma societaria ☐ SRL ☐ SPA ☐ SNC ☐ SAS ☐ COOP.VA ☐ Ditta Individuale
Numero addetti: ..... di cui, dipendenti .....

1.2. Quali sono le attività principali dell'impresa?
(indicarne l'incidenza percentuale sul fatturato aziendale)

attività	*%*
progettazione e design	
costruzione scafi e carpenteria navale	
falegnameria, arredi e allestimento interni	
officina meccanica e motori marini	
impiantistica idraulica e di areazione	
impiantistica elettrica ed elettronica	
produzione accessori per la nautica	
Servizi di vendita, noleggio e rimessaggio	
Attività di refitting	
Altri servizi (specificare)	
Altro (specificare)	
	100

1.3. Qual è la dimensione in termini di fatturato?

	2017		2018	
		di cui estero (%)		*di cui estero (%)*
Fino a 50.000	☐		☐	
Da 51.000 a 100.000	☐		☐	
Da 101.000 a 200.000	☐		☐	
Da 201.000 a 500.000	☐		☐	
Da 501.000 a 1.000.000	☐		☐	
Da 1.000.000 a 5.000.000	☐		☐	
Oltre 5.000.000	☐		☐	

1.4. L'impresa ha legami strutturali e/o giuridici (partnership-holding-etc.) con altre imprese?
☐ Si
_____
_____
_____
☐ No

2. MERCATO

2.1. Quali sono i segmenti principali per l'impresa?

segmento	% fatturato
Imprese di produzione	
Imprese di commercializzazione	
Privati	
Soggetti pubblici (PA)	
Altro _____	
Totale	100

2.2. Ampiezza del mercato di riferimento ed evoluzione prevista? *Indicare la percentuale % del fatturato*

territorio	%	diminuzione	stabile	incremento
Regione		☐	☐	☐
Altre regioni d'Italia _____		☐	☐	☐
Estero _____		☐	☐	☐
Totale	100			

(argomentazioni)_____
_____
_____

2.3. Ha mai lavorato per l'industria nautica?

☐ Si, in passato, ma ora non più
☐ Si, anche attualmente (PROSEGUIRE CON LA 2.5)
☐ No (PROSEGUIRE CON LA 2.8)

2.4. Quali le ragioni dell'interruzione?

Inadempienza (mancato pagamento)	
Tempistiche di pagamento	
Modifica condizioni contrattuali	
Decorrenza del contratto	
Altro _____	

2.5. Su quali fasi?
(elencare i segmenti)
_____
_____
_____

2.6. In quale territorio?

territorio	% fatturato	diminuzione	stabile	incremento
Regione		☐	☐	☐
Altre regioni d'Italia_____		☐	☐	☐
Estero _____		☐	☐	☐
Totale	100			

2.7. Quali sono le criticità e quali aspetti migliorerebbe nel rapporto di subfornitura?
_____
_____
_____

PASSARE ALLA 2.10

2.8. Sarebbe interessato ad avviare una relazione di subfornitura con il comparto della cantieristica navale?
☐ No
☐ Si (PROSEGUIRE CON LA 2.5, SALTARE 2.7)
(motivare) _____
_____
_____

2.9. In passato ha effettuato tentativi di approccio verso il comparto della cantieristica navale?

☐ No

(motivare) _____

_____

_____

☐ Si

(come, quanto tempo fa, su quale territorio) _____

_____

_____

2.10. Quale vantaggio competitivo ritiene di poter apportare ad un eventuale committente del comparto della cantieristica navale?

(articolare)

_____

_____

_____

2.11. Quali prospettive ritiene possano derivare dal comparto della cantieristica navale per l'azienda?

basso *alto*

1☐ 2☐ 3☐ 4☐ 5☐ 6☐ 7☐ 8☐ 9☐ 10☐

(motivare) _____

_____

_____

2.12. Quanto sono importanti vincoli e barriere da superare per l'ingresso nell'industria nautica come subfornitori?

basso *alto*

1☐ 2☐ 3☐ 4☐ 5☐ 6☐ 7☐ 8☐ 9☐ 10☐

(motivare) _____

_____

_____

2.13. Quali sono secondo lei i più rilevanti parametri di selezione dei subfornitori da parte dei cantieri navali? *(specificare l'ordine di importanza)*

	importanza				
Qualità	1☐	2☐	3☐	4☐	5☐
Prezzo	1☐	2☐	3☐	4☐	5☐
Tempistiche di consegna	1☐	2☐	3☐	4☐	5☐
Processi produttivi	1☐	2☐	3☐	4☐	5☐
Utilizzo di materiali leggeri	1☐	2☐	3☐	4☐	5☐
Localizzazione nella regione	1☐	2☐	3☐	4☐	5☐
Fidelizzazione	1☐	2☐	3☐	4☐	5☐
Altro specificare)	1☐	2☐	3☐	4☐	5☐

2.14. Se l'azienda è presente all'estero, in quali paesi e in quali modalità vi opera?

_____
_____
_____

□ Joint Venture
□ Investimento diretto: insediamento con unità produttive e/o commerciali

Se con "Investimento diretto", specificare dove sono collocate le unità, che attività svolgono e quando sono state aperte

_____
_____
_____

3. QUALIFICAZIONE PROFESSIONALE

3.1. Quali tipologie di figure professionali sono impegnate in "area produzione"? Si tratta di risorse interne o esterne?

	Ruolo	*Ris. Interne*	*Ris. Esterne*
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

3.2. Figure professionali che si vorrebbe inserire nell'organico:

	Numero
Impiantisti	
Falegnami/ebanisti	
Resinatori	
Autotrasportatori	
Tecnici _____	
Altro _____	
Altro _____	
Altro _____	

3.3. Criticità nel reclutamento del personale tecnico:

3.3.1. Quali forme di reclutamento?

_____
_____
_____

3.3.2. Che tipo di percorsi adottate per l'addestramento del personale (ris. interne)?

_____
_____
_____

3.4. Che tipo di programmi di formazione professionale, che siano in grado di competere con la contemporaneità, necessitano (in prospettiva futura)?

_____
_____
_____
_____

4. RAPPORTI CON UNIVERSITÀ E ISTITUTI DI RICERCA

4.1. Che tipo di relazioni avete con il sistema universitario e la ricerca?

- □ Nessun rapporto
- □ Presenza di hub per testare nuove soluzioni?
- □ laboratori
- □ contratti di ricerca (borse di dottorato)
- □ contratti di collaborazione
- □ stage curriculari
- □ altro *(specificare)*

_____
_____

5. PROSPETTIVE

5.1. Quali segmenti andrebbero valorizzati/promossi? *(specificare l'ordine di importanza)*

	ordine
Know-how	
Design	
Made in Italy	
Artigianato	
Eco-design	
Altro (specificare)	
Altro (specificare)	
Altro (specificare)	

ANNEX 4 - The companies interviewed

Cantiere delle Marche – Ancona – Naval shipyards

Cantiere Rossini – Pesaro – Naval shipyards

Cantori Spa – Ancona – Mobile production, general contractors, interior decoration

CPN Srl – Ancona – Construction

CRN Gruppo Ferretti – Ancona – Naval shipyards

Cromia Srl – San Benedetto del Tronto – Grouting, painting, hull finishing

Elettromedia Srl – Potenza Picena (MC) – Entertainment

Fincantieri – Ancona – Naval shipyards

Fratubi Srl – Ancona – Sale of steel products

Furlanetto International Srl – San Benedetto del Tronto – Shipboard electrical systems

Giorgio Niccolini – Ancona – Carpentry workshops

IGI Allestimenti Srl – Mondolfo (PU) – Nautical and residential furnishing

IMAR Srl – Urbino – Metal products and accessories

ISA Palumbo – Ancona – Naval shipyards

Mino e Grazia – Jesi – Upholstery

Roccheggiani Spa – Camerano (AN) – Heating, cooling and air treatment

Studio Massari Srl – Colli al Metauro (PU) – Interior design

Suretè Srl – Ancona – Guard service, fiduciary services, and logistics

Tende Tendenze Srl – Ancona – Floor and wall coverings, roofing, and outdoor furniture

Videoworks Spa – Ancona – Integration of audio/video, networking, domotics and entertainment systems

Vitrifrigo Srl – Vallefoglia (PU) – Industrial refrigeration (refrigerators cold storage, heat exchangers, mobile coolers)

Wider – Ancona – Naval shipyards

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Conclusions

This dissertation has had two purposes. Firstly, to contribute to a comprehensive overview of the current state of the Blue Economy (BE) in the world, highlighting challenges, opportunities, trends, and their potential for sustainable development (SD). To this end, Chapter I of the dissertation reviewed how the BE discourse is tied up in recent literature on economic development to establish the theoretical framework on which the dissertation is built.

Secondly, to provide a stocktaking tool based on solid foundation that will enable both policy-makers and stakeholders to make informed decisions to support relevant new initiatives and policies. To this end, Chapter II offered an evidence-based contribution on the development of China's BE by adopting an innovative model that considers the relationships among Quadruple Helix (QH) actors as a potential driver for connecting the country to foreign players. Then, Chapter III investigated the Chinese policy and initiative response to the United Nations' Decade of Ocean Science for Sustainable Development 2021-2030 to uphold the ecological protection of oceans as a way to guarantee the survival and development of human society. Lastly, Chapter IV examined the performance of the shipbuilding industry in the Marche Region, which is conceived as a catalyzer for regional economic development.

Chapter I filled the knowledge gap on how BE can constitute an economic development model for institutions and entrepreneurs. It did so by adopting an exploratory approach for the collection and review of a series of scientific contributions to be considered as most significant and most relevant in addressing the research question. Specifically, the exploratory approach was designed based on a set of criteria identified in compliance with the objectives of the investigation: 1) to frame and evaluate the state of the art with regards to policies and initiatives undertaken at global level; 2) to detect critical issues and challenges in the implementation of policies and initiatives; 3) identify policy implications and suggestions. While not a comprehensive list, the literature provides a starting point for future dialogue on a co-ordinated scientific platform supporting the BE agenda working towards a successful SD.

The results presented reveal some critical issues in the effective implementation of BE practices, namely: 1) the interdisciplinarity and the lack of a common agreed goal of BE; 2) the dichotomy between issues of sustainability and economic growth; 3) financial and investment issues; 4) shortcomings in MSP and pertinent legislation that impact on management of the multiple uses of marine environment. Accordingly, potential policy implications and suggestions were critically analyzed by means of providing specific reference and assessment to each of them. It is possible to leverage on nature-based solutions as potential means to enhance smart, sustainable and inclusive

growth. Yet, successful BE is dependent on the ability to communicate across vastly different perspectives.

To this regard, it is noteworthy that the role and significance of a strong network and coordination of relevant stakeholders – government, policy makers, industry, and researchers – together with the inclusions and involvement of local communities by adopting participatory approaches at governance and policy levels, emerged as an umbrella under which the specifity and uniqueness observed in technicalities of each criticality can be addressed. These are the people to focus on when scientific findings that illuminate paths or policy changes that could lead to more sustainable outcomes are communicated. The forthcoming years will be crucial in unlocking the potential of BE, through the cumulative impact of targeted research, continuous support to industrial development and deployment, and the streamlining of administrative procedures and funding instruments.

Chapter II contributed to the emerging literature on BE as a participative platform. Specifically, an innovative quadruple helix (QH) model is presented as a framework for comparing collaborative strategies for BE development. By applying the model to the case of Qingdao, the research sheds light on the role of clusters as industry-academia connectors that can support BE innovation also by promoting international ties with foreign industries and research centers. As for policy implications, the research stressed that the involvement of stakeholders is fundamental to provide marine policy makers and planners with accessible information on the marine economy both at the local and national level. The collection of data and insights from different stakeholders are necessary to ensure effective management and conservation of marine resources. These results contribute to the extensive literature on stakeholders' engagement for BE development.

Furthermore, based on the Chinese experience, involving civil society requires first awareness of BE issues and then the definition of action plans to include them in the decision-making processes. An approach may be to embrace the inherent ambiguities of the BE concept as an opportunity for ensuring flexibility and adaptability when applying the fourth helix model. In this regard, establishing common research and innovation trajectories for implementing actions pursuing a sustainable marine and maritime growth within dedicated policy frameworks does not mean solely to apply and exploit newly achieved knowledge, it implies instead establishing multiple connections and continuous adaptation to create new value, extend knowledge frontiers, and support innovative solutions, and ultimately contribute to a participative BE. For these reasons, sharing best practices among maritime economies that have experience in participative BE needs to be further encouraged.

The analysis of Qingdao through an innovative QH reveals that the city is still lacking in finding ways to incorporate the civil helix as a fourth helix. This model could instead bring greater

social benefits by empowering citizens who are not only passive consumers of content/services but take on the role of creators of innovation. Although China is forerunner in approaching BE logics already with the 11th and 12th Five-Year Plans thanks to the highly innovative and technological rate of the BE industrial sectors (in contrast to a more recent European interest), the scope of engagement and involvement of the civil society remains limited. This emerges from the innovative approach that the scientific contribution of this paper wanted to offer: the application of a typical Western explanatory model (QHM) for analyzing the Chinese context.

The discussion raised from the case study underlined the need to further investigate and compare collaborative perspectives in BE development. Nevertheless, the research is based only on qualitative data linked to desk research and interviews for a sample of experts. Therefore, it is necessary to validate the findings incorporating a qualitative methodology aimed at verifying the impact that domestic and international relationships on BE have on Qingdao competitiveness. As for future avenues of research, the QH acting as an enabler for international exposure may represent a base for comparing the development of other Chinese Blue Economic Zones and, to a larger extent, for investigating other international cases of BE. The comparison between cases would be useful for sharing best practices and foresting a common language on BE. Under this scenario, the spillover of novel research ideas on how to best integrate the fourth helix to the social and economic development agenda that the BE represents on a global scale is fascinating and it will be critical for future research to explore whether the four helixes of the BE can co-exist in practice.

Chapter III inquired into UN Decade of Ocean Science for Sustainable Development 2021-2030. Specifically, the Chinese response to the UN "Ocean Decade" is unfolded based on documentary analysis of official planning and strategic documents. The scale of the UN "Ocean Decade" is huge but it does stand as a once-in-a-lifetime opportunity. It is probably the largest campaign in the history of natural sciences or social sciences. By 2030, possible substantial progress should be achieved towards: identifying and removing sources of ocean pollution; mapping and protecting marine ecosystems; ensuring the ocean is harvested in a sustainable way; protecting people from ocean hazards; building capacity to understand and predict ocean conditions; opening up access to ocean data and technologies.

Accordingly, there is a tremendous opportunity in the coming decade to harness interdisciplinary advances in ocean science to achieve a better understanding of the ocean system and reduce the impacts on the ocean associated with the increase in human population and activities. To this end, a fundamental question to be addressed is how to help build science-policy and science-industry interfaces, and encourage solution-oriented research. Much of this will be made possible by investment in open sources of data, information and technology. On the other hand, the mobilization

of actors around the world and the engagement of many different stakeholders to create new ideas, solutions, partnerships and applications are critical. Connections between groups that perhaps had not worked closely together in the past, in a sort of multiple problem solvers platform – scientists, engineers, technology innovators, etc. –, will allow for science-based policy that results in solution-oriented actions. This will enable the delivery of timely information about the state of the ocean, and will allow for defining interconnected scenarios and pathways to achieve SD.

Against this backdrop, actions are needed from all states, including China. Even before the launch of the "Ocean Decade", President Xi Jinping called for strengthening cooperation in protecting the oceans, and in pushing forward ecological civilization construction while practicing the concept of the "ocean community with a shared future for mankind", which has gained worldwide resonance. Since then, various initiatives have been undertaken by the Chinese government to facilitate maritime connectivity, promote the integration of maritime cultures, and the development of the BE to improve maritime wellbeing. The establishment of a new model of international cooperation in Maritime Spatial Planning and the proposal to jointly build the 21st Century Maritime Silk Road stand as key actions to uphold such commitments. In 2021, in line with start of the "Ocean Decade", the 14th FYP highlights China's willingness to a more proactive engagement with regards to a "in-depth participation in global ocean governance", prompting the establishment of a "fair and reasonable international ocean regime" and the development of "blue partnerships". The excerpts of the 14th FYP selected in this Chapter show to be consistent with a broader agenda that Chinese policymakers have set when it comes to the marine domain. Protecting the marine environment, has been an integral part of this grand strategy and it has further materialized in the *14th FYP for National Marine Ecological and Environmental Protection*, which is the first FYP to guide marine ecological environment protection.

However, although it is extremely impressive to witness about the country's proactive engagement in the "Ocean Decade" with reference to the policy, strategies and initiatives analyzed, several challenges still remain for China to be addressed. First, as regards ocean science, challenges include insufficient observation and monitoring ability, inadequate understanding of global change and human impacts on the global ocean, and the science-based governance that China is not well equipped with. Second, under Chinese culture and environment, how to get broad society engaged is also an issue to deal with. The science community of China, including the young students, is actively engaged in the "Ocean Decade". But that is not enough. There is the need to attract the attention and promote the engagement of the public and different stakeholders. Third, how China can maximize its action in cooperating with other countries and training young scientists from other parts of the world constitute another challenge that need to be addressed.

The latter, in particular, opens up opportunities for EU-China cooperation. EMOD-PACE, which can be considered as the starting point of a new phase of strategic EU-China ocean relations, highlights the belief that by working together and learning from each other it is possible to advance the two countries' knowledge of seas and shared ocean, enabling more effective protection and sustainable management of the global ocean. Furthermore, in line with the adoption of more forceful policies and measures towards achieving carbon neutrality by 2060, 'going green' represents the core concept of China's high-quality economic and social development in the new era. Commitments of such kind bode well for European companies. By leveraging on their expertise and know-how, they can be strategic enablers of the decarbonization of the Chinese industry. The climate issue is closely related to all countries in the world. Achieving carbon peak and neutrality goals is an intrinsic requirement for China's high-quality development, that ultimately opens up opportunities of strategic relevance for European companies.

Lastly, Chapter IV presents the case study of the shipbuilding industry in the Marche Region, in Italy. The analysis of the latest studies on the sector contemplated with a survey and a series of semi-structured interviews with the top management of the most representative regional shipyards, and a sample of local small and medium-sized enterprises (SMEs), addressed the two main queries of the investigation: what impact can the positive performance of the shipbuilding sector have on the regional industrial system; what actions are needed to respond to the growing demand for qualified personnel. Overall, the in-depth exploration unveiled that the regional shipbuilding industry is a healthy system that can generate positive spill-overs on the regional supply chain. The experience and ability of local shipyards to cope with the strong tendency toward the customization of products and services revealed to be the key enabler behind the substantial growth rate (+39.5%) recorded in 2018, if compared to the national one (+9.5%). Specifically, building on the useful insights provided from the survey, three main potential drivers are identified to address the two main queries of the study and support the development of the regional shipbuilding industry and supply chain.

Firstly, some action is required on the part of the institutions to create a favourable ecosystem to support the competitiveness and maintain the health of the shipbuilding sector. The results of the analysis show that the production of the local shipyards is highly valued abroad, and that the rise of an increasingly knowledgeable and "creative" class of subcontractors is key to the success of the new nautical industry for the Marche Region. Moreover, the shipyards are growing increasingly interested in the refitting market. This is in accordance with the global refitting market which, in perspective, appears to be a large and promising business. To this regard, it will be essential to undertake some strategic programming targeted on integrating and coordinating the many SMEs in the industry. Considered the excellence of regional manufacturing, the local institutions could lay the groundwork

for the creation a sort of "nautical cluster", which seems to be an ideal strategy where numerous benefits could derive from a strong synergy between public and private. Fostering technological innovation within the cluster would eventually contribute to the creation of a "regional identity trademark". The development of synergisms between public administrations, businesses and research facilities would certainly feed a virtuous cycle for effective management of the resources and the creation of a shared vision that positively impact on the regional industrial system.

A second pathway concerns the training of technical professionals who are able to satisfy the demands that come from the shipbuilding sector. Case studies in the supply-chain seem to highlight a problem in the recruitment of highly qualified professionals, which is partially due to the fact that relations with the educational system and universities exist but are insufficient. In this regard, there is the need to recognize these demands with the resources made available by the public educations system (technical industrial and nautical schools) and private schools; on the other, there is the need to provide the types of courses necessary to train the professional skills that are most in demand in the sector, also by making them more attractive to the young generations. For these reasons, in addition to programming a public training program coherent with those needs, it could be useful to establish a public-private "academy" that, with the support of the public stakeholder, directly involves the enterprises (both the shipyards and subcontractors) and leverage on the willingness shown by artisan businesses to support training courses capable of transferring their skills to young people interested in learning a trade.

The third pathway intends to respond to the current distance between the shipyards and the potential local suppliers in the Marche Region. If the shipyards say they are unaware of opportunities available to them in the regional manufacturing system, it is also true that the businesses are not sufficiently assertive in offering themselves as suppliers or in adapting their products to "nautical use". In this sense, it is important to strengthen relations and forms of networking between the different players in the shipbuilding sector. This goal can be achieved in two complementary ways. First, the local business associations could play an important role in facilitating and organizing meetings, workshops, and other contact opportunities. This action should, on the one hand, create a more open community and greater sharing of information about what is being done in the shipbuilding sector; on the other, it could try to involve new entrepreneurs who, though not working directly with the shipyards, could gain entry by offering "nautical" versions of their products. Second, the creation of a "regional catalogue of specialized suppliers" would stimulate more awareness and engagement with a consortium of top regional suppliers.

In a nutshell, the common policy thread that emerged as prominent from this dissertation is that the only BE we can afford to have in the future is one that is scientifically managed. Education

and ocean literacy are paramount to secure the base and the sustainability over time of ocean-science. To achieve SD through the BE, good science is needed to inform policies, increase the knowledge and the engagement of all stakeholders and ultimately deliver scientific solutions to address the decline in ocean health. The success of the BE strongly relies on the contributions of many different stakeholders including scientists, governments, academics, policy-makers, business, industry, funders and civil society. As such, a series of stakeholder engagement mechanisms should be designed in order to facilitate mutual learning within and across stakeholder communities and ensure robust communication within and across them. Convening existing or new groups of BE actors in a shared platform or cluster with fluid boundaries is a way to stimulate the multi-stakeholders engagement that the BE advocates. Stronger connections and knowledge exchange between these groups are the game-changers in implementing BE actions that deliver greater benefits for the ocean ecosystem while safeguarding economic development. Critically, governments and institutions play a fundamental role in unleashing such a potential.