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Towards a Blue Economy: The Influence of Policy Strategies in the Research and Technology Orientation of Portuguese Firms

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Abstract: The "Blue Economy" was strategically identified as a driver of European growth, through the development of new competences and activities that enable a sustainable exploitation of ocean resources. Research and innovation policies oriented to the Blue Economy, at both European and country levels, can be described as attempts at "mission-oriented" policies, which seek to influence the direction of growth towards sustainable transformative change in the ocean area. The objective of this paper is to analyse the directions followed by the research and technological development (RTD) activities conducted by Portuguese firms in order to understand whether the strategies and policies aiming at the development of the Blue Economy are being effective in their endeavour of steering such development in certain directions, thus creating conditions for a sustainable transformation in ocean related areas. The results provide some evidence of the role being performed by RTD promoted by these policies towards a transformative change in ocean related activities. Particularly, they show that they are contributing to: i) the generation of new areas and the revitalisation of existing sectors, through the creation and exploitation of new technological opportunities; and ii) a sustainable use of resources and the mitigation of negative environmental effects created by previous activities. Moreover, the results show intense interaction between different types of organisations. Particularly, they show that new technology intensive firms and industries are working together with existing firms from traditional sectors to exploit the new opportunities and technologies. The evidence suggests processes of cross fertilisation and technological upgrading of traditional activities, through the interaction in the RTD projects funded by clearly targeted public policies.

Keywords: Blue economy, policy strategies, challenge-led policies, research & development, sectoral interactions, sustainability

1. Introduction

The "Blue Economy" was strategically identified as a driver of European growth, through the development of new competences and activities that enable a sustainable exploitation of ocean resources (EC, 2012). Strategies and policies were formulated to address this challenge, combining industrial growth objectives with sustainability concerns.

Research and innovation policies aiming at the development of the Blue Economy can be described as attempts at "mission-oriented" policies (Mazzucato, 2018a), which seek to influence the direction of growth towards sustainable transformative change in the ocean area. Policy initiatives such as the EU Blue Growth strategy (EC, 2012, 2019) or the Portuguese National Ocean Strategy 2013-2020 and Mar-Portugal Action Plan (RCM, 2014; DGPM, 2015), are examples of this mission-oriented approach. They present research and innovation activities as contributing to sustainable growth and job creation in the Blue Economy, through the development of emerging industries with growth potential, and the transformation of established industries with strong weight on European economies; and through a better understanding of the marine ecosystems and the protection and preservation of natural resources and the environment. These strategic objectives were translated into research and technology development (RTD) funding instruments, whose terms guide the activities of the actors engaged in ocean-related innovation activities.

The objective of this paper is to analyse the directions followed by the RTD activities conducted by Portuguese firms in the context of projects funded by national and European programmes, in order to understand whether the policies aiming at the development of the Blue Economy are being effective in their endeavour of steering such development in certain directions, thus creating conditions for a sustainable transformation in ocean-related areas. In particular the paper investigates whether there is some evidence that these policies are contributing to: i) generate new areas of activity and revitalise established ones; ii) ensure that these activities

entail a sustainable use of natural resources and a lower environmental impact, or mitigate the negative effects of previous activity.

2. Literature review

The Blue Economy is a somewhat ambiguous concept that can be used in diverse and sometimes competing ways by different actors (Voyer et al, 2018; Silver et al, 2015). However one of its central tenets is the attempt to combine socio-economic development and sustainability concerns, when addressing on-going and future human activities related with the ocean (Voyer et al, 2018). In particular it contemplates the need to substantially transform the way ocean-related activities are conducted, in what concerns their content – e.g. upgrading existing industrial sectors or creating new ones; and their impacts on the natural resources and the environment – e.g. changing producer and consumer practices towards sustainability, introducing new actions focusing on environment protection. This transformation is a complex process that requires changes at different levels and the involvement of a variety of actors and institutions.

The nature and magnitude of these processes resounds with those described by the sustainability transitions literature, which addresses processes of transformation in the way key societal functions are fulfilled, describing them as complex, involving far reaching changes at technological, institutional, organizational and social levels (Markard et al, 2012). In addition, the preoccupation of combining sustainability with socio-economic development echoes recent issues raised by that literature, regarding the need to ensure that new sustainable technologies have a positive impact on the economy (Andersen et al., 2020). Sustainability transitions are often associated with processes of "creative destruction", i.e. processes through which new technologies challenge existing firms and technologies, making the technologies obsolete and forcing the firms to withdraw from the market (Kivimaa & Kern, 2016). However, as the "just transition" literature (McCauley & Heffron, 2018) points out, while technological change is essential for transition, not enough attention is paid to the negative impacts of the resulting "competence destroying innovation" on some existing activities, which have a strong weight in the economy of many countries and may have difficulties to adapt. Given the serious socio-economic effects that such "destruction" can have upon the regions/populations that depend on those activities, it is important to understand what types of transformative processes can contribute to mitigate those effects, including reconfiguring the affected activities. Recent research on the interaction of new sustainable technologies with the context in which they emerge, addressing the co-evolution between the new technologies and the established sectors (Fontes et al, 2019a; Steen & Weaver, 2017), is a step in that direction.

In this paper we argue that the Blue Economy concept and the associated "Blue Growth" strategies are a good setting to examine these issues. They address the ocean and ocean-related activities as a system and provide a context in which sustainable transformative changes can be enacted that favour creation and compensate for the effects of destruction. This is because they offer conditions for the interaction between previously unrelated activities, namely for the engagement of actors associated to emerging technologies (e.g. biotechnology, robotics, renewable energies) and actors associated to established activities (e.g. fisheries, shipbuilding, sea transportation) into acting – ideally in collaboration – towards the reconfiguration of existing activities and the creation of new ones; and into conducting their activities according to more sustainable attitudes regarding the use of ocean resources and the environment.

These types of transformation require the presence of a new type of innovation policies – challenge-led policies - which go beyond objectives of growth and competitiveness *per se* and seek to address major societal problems or challenges, by the means of research and innovation (Schot & Steinmueller, 2018; Mazzucato, 2018a). These policies aim to steering innovation and socio-economic impact in a particular direction, in order to achieve desirable transformative changes.

There are different approaches regarding the emphasis and design of these policies, which reflect different views on the innovation process (Diercks et al, 2019). One particularly influential approach has been that of the "mission-oriented" innovation policies, whose aim is turning grand societal challenges into concrete problems that can drive innovation across multiple sectors and actors (Mazzucato, 2018a; Foray et al, 2012). The formulation of clearly defined missions, focused on solving societal problems, enable governments to influence the direction of growth by "making strategic investments throughout the innovation chain and creating the potential for greater spillovers across multiple sectors, including low-tech sectors" (Mazzucato, 2018a: 806).

This approach inspired the European Commission in the formulation of European Union (EU) policies. It has namely influenced the formulation of the Framework Programme for Research and Innovation launched in 2014, the Horizon 2020 (2014–2020), in which broad societal challenges were combined with driving economic growth (Mazzucato, 2018b). Its influence extended to various EU member states, which have started to introduce changes in their innovation policies that reflected a challenge-led/mission-oriented perspective.

A mission-oriented approach equally appears to be behind the European "Blue Growth" strategy that defined the opportunities for marine and maritime sustainable growth (EC, 2012). In fact, the Blue Economy was identified as a driver of European growth, through the development of new competences and activities that "harness the untapped potential of Europe's oceans, seas and coasts for jobs" while simultaneously striving to "use the sea sustainably and respect potential environmental concerns given the fragile nature of the marine environment" (EC, 2012). Strategies and policies were defined to achieve these goals, targeting the broad variety of actors engaged in sea-related activities, both new and established. Research and innovation, aiming at the revitalisation of established sectors and the development of emerging industries, as well as at a better understanding of the marine environment and the requirements for its preservation, were regarded as key elements in these strategies. In the case of Portugal, the Blue Growth strategy influenced the National Ocean Strategy 2013-2020 and the Action Plan for the Sea (RCM; 2014; DGPM, 2015), which have similar goals and scope (Fontes et al, 2019b).

The European and country specific strategies and policies represent initial and often experimental attempts towards an implementation of the new type of innovation policies, still revealing many limitations (Diercks et al, 2019; Schot & Steinmueller, 2018). But in spite of that, they may have started providing a context that can favour the type of transformative change discussed above. Some features that can contribute to this include:

- Address societal problems, going beyond a focus on growth and competitiveness and including social and environmental goals.
- Formulate and support clear objectives that permit to coordinate the innovation efforts of a wide range of actors towards these broader goals.
- Favour the involvement of different types of actors (public and private), originating from a variety of domains of activity, including different industries (new, established, declining).
- Encourage different actors' co-engagement in experimenting with innovations that can contribute to a shared goal.

Against this background, the objective of this paper is to contribute to understand the extent to which the definition and early implementation of strategies for the development of a Blue Economy, is creating conditions for a sustainable transition in ocean-related domains. That is, to a systemic change that simultaneously: i) generates new areas of activity and revitalise established ones, contributing to create or maintain jobs and to the livelihood of populations that depend on the ocean; ii) ensures that these activities entail a sustainable use of natural resources and a lower environmental impact, or mitigate the negative effects of previous activity, contributing to the sustainability of oceans and coastal areas.

For that purpose, the analysis starts by identifying the areas defined in the European and Portuguese policies as composing the Blue Economy that are priority targets for policy action, and subsequently examines whether these policy objectives are influencing the directions followed by RTD activities conducted by Portuguese organisations, in the context of projects funded by European and national programmes.

In what concerns the identification of the target areas, a recent European document (EC, 2019) defines the Blue Economy as encompassing "all sectoral and cross-sectoral economic activities related to the oceans, seas and coasts", including "the closest direct and indirect support activities necessary for the sustainable functioning and development of these economic sectors" and comprising "emerging sectors and economic value based on natural capital and non-market goods and services". It also specifies the priority areas for action that are listed in Table 1, column 2.

As pointed out above, the Portuguese National Ocean Strategy 2013-2020 was strongly influenced by the European Blue Economy framework. Therefore, there is a strong overlap between the Blue Economy priority areas defined at European level and the Strategic Development Domains (SD) and Programme Areas defined in the Mar-Portugal Action Plan (DGPM, 2015), even if there are some differences in thematic aggregation and

sectoral organisation, reflecting some country specificities. Table 1 compares and relates both approaches and also qualifies the areas as established or new. A more detailed description of the strategies and their translation in priority areas can be found in Fontes et al (2019b). Since the analysis focuses on the Portuguese organisations, the paper adopted the Portuguese version of the Blue Economy target areas, as listed in the first column of Table 1.

Table 1: Blue Economy priority areas in European and Portuguese strategic documents

PLAN MAR PORTUGAL (DGPM, 2015)	BLUE ECONOMY REPORT (EU, 2019)	Type
SD Governance		
Strategic thinking and action		
Education (ocean literacy)		N
Identity and culture		N
Protection & safeguard	Maritime Defence	N
SD System		
Ocean	Natural capital and ecosystem services	NC
Atmosphere	Natural capital and ecosystem services	NC
Integrated system	Natural capital and ecosystem services	NC
SD Natural resources: Living resources		
Fisheries and fishing industries	Marine living resources – Fisheries	E
Aquaculture	Marine living resources – Aquaculture	E
Marine biotechnology	Blue Bio economy	N
SD Natural resources: Non-living resources		
Marine mineral resources	Marine minerals & extraction of mineral, oil and gas	N&E
Marine energy	Blue energy	N
Infrastructure, uses and activities		
Ports, transport & logistics	Ports, warehousing & maritime transport	E
Recreation, sports and tourism	Coastal tourism	E
Shipbuilding	Shipbuilding & repair	E
Maritime works	(Ports, … and) water projects	E

Legend: E-established sectors; N – new industries; NC – new areas/natural capital

Subsequently the paper analyses the projects funded in the Blue Economy areas, in order to understand whether there are indications that these policies are starting to have an impact upon the innovative behaviour of actors, in this case private companies. In particular it looks for evidence of:

- opportunities for interaction between firms from distinct sectors that potentially would not cross (Frenken & Janssen, 2019);
- emergence of new activities, which may still assume the form of new "niches", but can be the embryo of a new dynamics for the field (Smith & Raven, 2012);
- efforts towards a more sustainable behaviour, both in the way existing activities are performed and in the development of activities directed towards resource conservation or environmental stewardship and protection (Voyer et al, 2018)
- opportunities for the involvement of firms from sectors that have less tradition of research and innovation activities but operate in targeted application areas, leading them to engage in collective processes that may have a changing impact on their activities (Fontes et al, 2019a);
- processes of cooperation between firms and other organisations - public or from civil society - that manage/coordinate activities related to climate change, environment conservation, preservation of natural resources, that may improve the performance of these activities.

3. Methodology

The paper uses an exploratory approach, using a descriptive analysis – to characterise the activities and the actors – and social network analysis – to characterise the relations between the actors. Data analysis was conducted on two groups of RTD projects: 1) European projects funded by the Horizon 2020 with the participation of Portuguese firms; 2) projects funded by various operational programmes from the Portugal 2020 framework programme that involved Portuguese firms.

To identify the European funded projects, a search was conducted in the database provided by the Community Research and Development Information Service (CORDIS)[1], using a series of keywords related with the ocean and with sea-related activities and industrial sectors. As a result of this process we identified and collect data on 72 European funded projects

To identify the projects funded in Portugal, a search strategy similar to the one described above was conducted on several sources: the project database of the National Innovation Agency (ANI) and the lists of funded projects provided by the Portugal 2020 framework programme[2] and by the Fundo Azul programmes, which focuses on emerging domains [3]. Since the latter two only provide information on the project coordinator, online searches were necessary to identify the remaining participants. As a result of this process we identified and collect data on 96 Portuguese funded projects. After this data collection procedure, a new database was built for the 168 projects.

To capture the interactions between the organisations involved in the projects, a Social Network approach was used. Each project was considered a 2-mode network, where the projects are the events and the participants are the actors. Dyads between the Portuguese firms and the remaining project partners were reconstructed: it is considered that a Portuguese firm is tied to another organisation if they are/were participants in the same project. In this process the type of organisation, the industrial classification of Portuguese firms and the nationality of the partners (Portuguese vs. non-Portuguese) were considered. Network diagrams were prepared using the Netdraw software.

4. Results

In order to address the issues raised above, the data obtained was analysed with a view to answer to two sets of questions.

The first set of questions addresses the influence of the Blue Economy policy directions, as expressed in the priority domains/areas, in the RTD activities of Portuguese firms:

- Q1a: Are some strategic areas being privileged and others left behind?
- Q1b: In particular, are the RTD activities addressing both emerging areas and more established ones? Which is the balance between them? Which types of firms are addressing the different areas and with which types of partners?
- Q1c: Are RTD activities with firm involvement addressing sustainability concerns?

Table 2 presents the distribution of projects and respective funding by Blue Economy domain/area, showing the central position of research concerned with the exploitation of natural resources. The Living Resources domain has the highest number of projects (47.6%) and investment (37.3%). But projects targeting established areas such as fisheries and aquaculture have a relatively lower weight than those on the new area of marine biotechnology, which is the most important area in terms of projects (28.6%) and the second in investment (20.7%). The Non-living Resources domain is almost exclusively composed of projects in the Marine Energy area, since exploitation of marine mineral resources is underdeveloped in Portugal. Marine Energy is also the single area with the highest investment (24.9%), reflecting the capital-intensive nature of the projects.

Table 2 also shows that the System domain and the Infrastructure, Uses and Activities domain jointly occupy a second position, with similar weights in terms of number of projects (16.1% and 15.5%), although the former concentrates a higher investment (18.4% vs. 9.9%). The System domain is concerned with preserving and increasing the ocean natural capital and the projects focus either on knowledge development about the ocean ecosystem (Ocean area) or on modes of monitoring, risk assessment and conservation, to account for the effects of the diverse uses of the ocean (Integrated area). The Infrastructure, Uses and Activities domain encompasses research targeting sea-related industries. The relatively low investment is mostly concentrated in one area - Ports, transport & logistics. But there are also several projects developing technologies of a transversal nature that can be applied in a variety of marine-related sectors.

[1] CORDIS: https://cordis.europa.eu/projects
[2] Portugal 2020: https://www.portugal2020.pt; Fundo Azul: https://www.dgpm.mm.gov.pt/fundo-azul
[3] ANI: https://www.ani.pt/; Portugal2020: https://www.portugal2020.pt/content/lista-de-operacoes-aprovadas; Mar2020: http://www.mar2020.pt/;

Finally, the Governance domain, mostly concerned with state-related activities, has the lowest level of activity. But it is worth mentioning the weight of projects with firm participation in the Protection and Safeguard area.

Table 2: Number of projects and funding by Blue Economy target domain and area

Domain/Area	Type area	N projects	%	Funding	%
Governance		**12**	**7,1%**	**8.608.530,44 €**	**7,7%**
Strategic thinking and action	N	1	0,6%	1.386.616,25 €	1,2%
Education (ocean literacy)	N	0	0,0%	0,00 €	0,0%
Identity and culture	N	0	0,0%	0,00 €	0,0%
Protection & safeguard	N	11	6,5%	7.221.914,19 €	6,5%
System		**27**	**16,1%**	**20.469.780,27 €**	**18,4%**
Ocean	NC	13	7,7%	5.737.161,78 €	5,1%
Atmosphere	NC	0	0,0%	0,00 €	0,0%
Integrated	NC	14	8,3%	14.732.618,49 €	13,2%
Natural resources: Living resources		**80**	**47,6%**	**41.625.192,16 €**	**37,3%**
Fisheries and fishing industries	E	13	7,7%	3.217.909,33 €	2,9%
Aquaculture	E	20	11,9%	9.070.763,09 €	8,1%
Aquaculture & Fisheries	E	2	1,2%	6.720.518,13 €	6,0%
Marine biotechnology	N	45	26,8%	22.616.001,61 €	20,3%
Natural resources: Non-living resources		**23**	**13,7%**	**29.806.945,93 €**	**26,7%**
Marine mineral resources	N&E	3	1,8%	2.038.689,71 €	1,8%
Marine energy	N	20	11,9%	27.768.256,22 €	24,9%
Infrastructure, uses and activities		**26**	**15,5%**	**10.993.665,31 €**	**9,9%**
Ports, transport & logistics	E	12	7,1%	4.620.135,12 €	4,1%
Recreation, sports and tourism	E	0	0,0%	0,00 €	0,0%
Shipbuilding	E	3	1,8%	953.813,00 €	0,9%
Maritime works	E	4	2,4%	1.811.607,89 €	1,6%
Combination of activities (transversal)	N&E	7	4,2%	3.608.109,30 €	3,2%
Total		**168**	**100,0%**	**111.504.114,11 €**	**100,0%**

Legend: E-established sectors; N – new industries; NC – new areas/natural capital

The aggregation of information about the nature of the areas targeted, presented in Table 3, shows that, overall, there is a stronger focus on new areas and that, among these, RTD projects targeting new industries prevail over those on natural capital, which is not unexpected since we are analysing only projects with firm involvement. But there still are a substantial number of projects targeting established sectors, particularly among those funded by national programmes, as well as a few projects whose applications can encompass both new and established industries.

Table 3: Nature of areas targeted: new versus established

Nature of targeted area	Nº projects	%
New areas - new industries	76	45,2%
New areas - natural capital	22	13,1%
Established sectors	54	32,1%
Mixed targets	16	9,5%
Grand Total	**168**	**100,0%**

Going back to questions Q1a & Q1b, these results suggest that the strategy had some partial success in directing the focus of RTD activities towards industrial sectors that would be less likely to become involved in those types of activities. However, this effect is mostly concentrated in sectors related to the exploration of natural resources – fisheries and aquaculture - which are equally the target of several RTD projects in one of the new areas: marine biotechnology. These are sectors that have an important weight in the Portuguese economy (PWC, 2020) and whose upgrading can be potentiated this way. Other established sectors were much less able to become object of RTD activities, the only exception being the area of ports and marine transport. On the other hand the results reveal the importance of two emerging industries - marine biotechnology and marine renewable energies – in which the country had previously been building competences (Fontes, 2007; Sarmento et al, 2014) that the strategic focus contributed to further consolidate.

Regarding the type of firms that constitute the project team (Table 4), it should be noted that, in all domains, teams formed only by technology intensive firms predominate, being particularly dominant in the new areas.

Teams that bring together different types of firms (tech and non-tech) have a greater weight in the Non-living Resources domain (22%), namely in the marine energy area, and in the Living Resources domain (20%). The teams only composed of non-technology intensive firms, are mostly present in the Infrastructure, Uses and Activities domain (39%). In this domain, teams tend to be either exclusively composed of technology intensive firms (39%) or of non-technology firms (57%), the existence of partnerships between the two types being residual (4%).

Table 4: Type of firms and team composition by target domain and area (number of projects)

		Team		Type of Firm		
Domain/Area	**Type area**	**Only Firms**	**Firms & Other**	**Only Tech**	**Tech & Non-Tech**	**Only Non-Tech**
Governance		**5**	**7**	**9**	**2**	**1**
Strategic thinking and action	N	0	1	1	0	0
Protection & safeguard	N	5	6	8	2	1
System		**9**	**18**	**19**	**3**	**5**
Ocean	NC	1	12	7	2	4
Integrated	NC	8	6	12	1	1
Natural resources: Living resources		**38**	**42**	**48**	**16**	**16**
Fisheries and fishing industries	E	7	6	6	3	4
Aquaculture	E	6	14	12	5	3
Aquaculture & Fisheries	E	0	2	1	1	0
Marine biotechnology	N	25	20	29	7	9
Natural resources: Non-living resources		**6**	**17**	**15**	**5**	**3**
Marine energy	N	5	15	14	4	2
Marine mineral resources	N&E	1	2	1	1	1
Infrastructure, uses and activities		**11**	**15**	**15**	**1**	**10**
Ports, transport & logistics	E	2	10	7	1	4
Shipbuilding	E	2	1	2	0	1
Maritime works	E	3	1	1	0	3
Combination of activities	N&E	4	3	5	0	2
Total		**69**	**99**	**106**	**27**	**35**

Legend: E-established sectors; N – new industries; NC – new areas/natural capital

Considering the types of organizations that constitute the project teams (Table 4), we distinguished between teams only with firms and teams that involve partnerships between firms and other types of organizations. Table 4 shows that there is a balance between the two types of teams. Exceptions are the Non-living Resources domain and the System domain, in which partnerships between firms and other organizations prevail (respectively 74% and 67% of projects). Partnerships are more frequently with research organisations, but they can also involve public and other organisations, individually or in combination.

Finally, in what refers to sustainability concerns (Q1c), it was possible to identify 31 projects (18.5%) that focused on resource conservation or environmental stewardship and protection, the majority in the System domain, and a few in the Governance domain. However, there was also a substantial number of industrial development projects that explicitly included sustainability goals, concerning changes in the performance of the activities or impact mitigation actions.

The second set of questions inquires if the Blue Economy policy directions are creating opportunities for industrial change in marine and marine related areas, involving both new firms active in new areas and existing companies from established sectors, as well as transformative interactions between them, namely:

- Q2a: Are the RTD projects creating opportunities for interaction between firms from distinct sectors, enabling cross fertilisation?
- Q2b: In particular are they creating opportunities for the involvement of firms from application sectors that have less tradition of research and innovation activities, namely through collaboration with firms in emerging areas, which may subsequently induce upgrading processes in the former?
- Q2c: Are there some established sectors in which these processes are more active? Are there some new industries/firms that are driving these processes?

Figure 1 shows the network built from the relationships established by the Portuguese firms within the scope of the RTD projects. The network involves 964 organisations (231 Portuguese, 733 foreign) that are classified according to their type and, in the case of Portuguese companies, according to their 5-digit NACE code. The nodes in the network reflect this classification, represented by the colours in the diagram: red for firms, yellow for research organisations, blue for public organisations and green for other organisations. The size of the node is proportional to the number of organisation for each type of actor.

The network is composed of 609 dyads between the Portuguese firms and their project partners: the dashed lines represent ties that reflect collaborations in EU funded projects and the continuous lines represent ties that reflect collaborations in national funded projects.

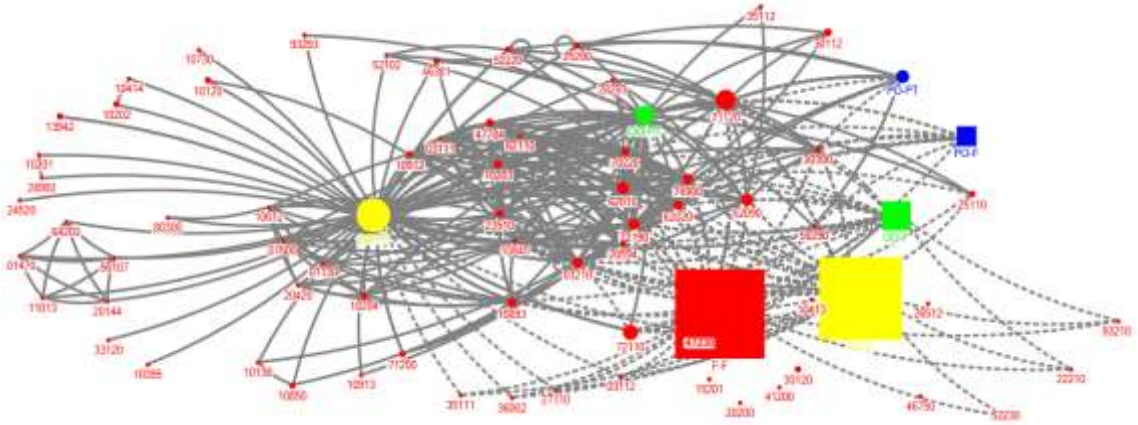

Figure 1: Relationships established by the Portuguese firms within the scope of the RTD projects

It is possible to conclude that the RTD projects are offering opportunities for collaboration between Portuguese industrial sectors and between them and other types of partners, with emphasis on foreign firms and research organisations, and national research organisations. This networks reflects the fact that a wide variety of industrial sectors are exploiting the new opportunities related to the Blue Economy, both in established activities related to ocean (e.g. ports and fisheries) or application activities (e.g. agrofood), and in new activities (e.g. biotech, R&D services, ICT). The network – which is a sole component quite dense since 12% of possible ties are active – also suggests the existence of opportunities that go beyond those associated with single projects: some firms – particularly from technology-intensive sectors - are active in several projects, both at EU and national levels and bridge several types of partners (including firms from different sectors).

To better capture the interaction between Portuguese firms from different sectors, we have isolated these firms from the above network, resulting on two different diagrams shown in Figure 2. In the left panel (a) all sectors are included while in the right panel (b) only non-technology (application sectors) are included. It is visible (panel a) that although some sectors only establish partnerships with non-industrial organisations, (appearing as isolates in the graph, while previously were connected), most sectors are interacting in these projects, in order to develop new opportunities, related to new technologies or to sustainability concerns. Therefore, we found some evidence of cross fertilisation between firms from different sectors (question 2a).

(a) (b)

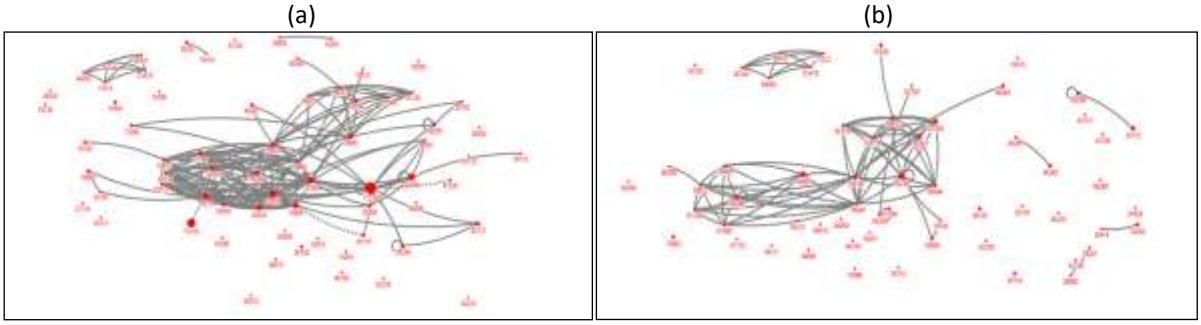

Figure 2: Relationships established between Portuguese firms within the scope of the RTD projects

Moreover, we find that these interactions involve both firms from application sectors, traditionally less involved in RTD activities and firms from new industries (more technology intensive). In panel (a) we see the existence of

several sectors where these interactions occur: ports, fisheries, aquaculture, agrofood, metal products (question 2b). In panel (b) we see that if we remove from the network these more technology intensive industries (frequently positioned in industrial classifications such as engineering, technical consultancy, computing, scientific and professional activities, or research and development), it becomes much more fragmented, suggesting a role played by firms in these industries in driving the exploitation of the new opportunities related to the Blue Economy (question 2c).

5. Conclusion

This paper sets out to explore the effect of public policies aiming at the development of the Blue Economy on the direction of RTD activities conducted by Portuguese firms. It argues that the "Blue Growth" EU and Portuguese strategies and policies can be understood as an attempt to adopt a mission-oriented approach, contributing to: i) generate new areas of activity and revitalise established ones with impact on growth and job creation; ii) ensure that these activities are enabling a sustainable transformation in ocean-related activities.

The results provide some evidence towards a transformative role being performed by the RTD activities promoted by these policies, potentially leading to sustainable change in ocean related activities. Particularly, they show that RTD activities are contributing to: i) the generation of new areas (e.g. marine biotech or marine energy) and the revitalisation of existing sectors (e.g. fisheries and aquaculture and, to a less extent activities concerned with water transportation), through the creation and exploitation of new technological opportunities; and ii) to a sustainable use of resources and to the mitigation of negative environmental effects (which is the exclusive focus of several projects and also explicitly part of the goals of several industry-oriented projects).

Moreover, the results show intense interaction between different types of organisations, particularly different types of firms. We have found that new technology intensive firms and industries are often working together with existing firms from traditional sectors to exploit the new opportunities and technologies. A particularly interesting case is the interaction between a new science-based area that has been object of an important public investment in Portugal – biotechnology – and a set of established resource-based industries that have an important position in the Portuguese economy and a strong weight in the livelihood of some regions – fisheries, aquaculture, and sometimes also involving food processing. This is a good example of processes of cross-fertilisation and technological upgrading of traditional activities that can be promoted by clearly targeted challenge-led policies. This type of experience deserves a more in-depth examination, in order to offer policy insights into how to further encourage and uphold these virtuous transformational dynamics.

Overall, the results show that the Blue Economy policies are having some success in directing the activities of Portuguese firms towards some of the areas they define as priority, but also that some established areas are still being left behind, potentially requiring additional efforts. It is thus important for policymakers to take stock of the implications of this partial success, with a view to understand the conditions that explain the limited involvement of some sea-related sectors, as well as the lack of engagement of research-intensive companies in joint-activities with them.

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