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Opportunities for Economic Revitalization Through Inter-Industrial Relationships: The Case of Blue Economy

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Abstract: This paper proposes that collaborative relationships in the context of research and innovation projects can be a first step towards the development of new products or adaptation to new markets that may drive diversification processes in established/mature sectors; and that technology-based firms can play a key role in these processes, as intermediaries and co-innovators. It addresses the case of projects in the field of "blue economy", which aims at combining socio-economic development and sustainability in the conduction of human activities related with the ocean. Transformative activities in this field are especially important, given the weight of ocean-related traditional sectors in the economic activity of several European countries. The paper maps the interactions between new and established Portuguese industries, to investigate whether and to extent inter-sectoral relationships are leading to the development of innovative and sustainable solutions, as well as which sectors have a more determinant role. Then it looks for evidence of revitalization and transformation processes being induced by collaboration with firms from new industries. Implications for transformative innovation policies are derived.

Keywords: industrial transformation, diversification, blue economy, inter-industrial relationship, research & innovation projects, social network analysis

1. Introduction

The "Blue Economy" is considered one of the drivers of European growth, based on the development of new competences and activities that enable a sustainable exploitation of ocean resources (EC, 2012). Strategies and policies were formulated, both at the UE and national levels, to address "Blue growth", combining industrial growth objectives with sustainability concerns. These strategies have targeted a broad variety of actors engaged in ocean-related activities, namely companies from established and new industries, and have promoted the development of new transversal technologies through the support of research and innovation.

These new, transversal technologies – such as advanced materials, biotechnology, ICTs, robotics - have the potential to drive changes in established industries, contributing to their transformation and economic revitalization. However, the ways these processes take place are still underexplored. The paper addresses this gap by proposing that such revitalization can be achieved through the promotion of inter-industrial relationships between established and new industries and the adoption, by companies from the established sectors, of diversification strategies based on the exploitation of the opportunities opened by the collaborations established.

The paper conducts an empirical analysis of the role played by research and innovation projects in the creation of conditions for a fruitful interaction between previously unrelated activities in the field of Blue Economy, conducive to change in mature industries. Transformative activities in this field are especially important, given the weight of ocean-related traditional sectors in the economic activity of several European countries, and the need to revitalize their activities, particularly in the context of a post-pandemic recovery.

2. Literature review

The concept of Blue Economy emerged as result of the growing interest in the development of a set of sectors directly or indirectly related to the ocean that have a strong weight in the economy of several countries, combined with concerns about the effects of these activities upon the integrity and sustainability of ocean ecosystems (Howard, 2018; Voyer et al, 2018). This dual approach was translated in strategies and policies at the European and country level, namely research and innovation policies aiming at the revitalization of established sectors and the development of emerging industries, while guaranteeing the sustainable use of resources (Fontes et al, 2019; EC, 2012).

The introduction of new transversal technologies has been an important element of these policies. Besides contributing to the development of new activities and businesses, these technologies are expected to play a role in the revitalization and upgrading of established sectors (Dolata, 2009), which can be particularly relevant for mature sectors experiencing economic stagnation or decline. However, the processes through which the development of new technologies can simultaneously induce changes in established sectors are still insufficiently understood (Andersen et al, 2020).

Drawing on insights from the innovation literature, which describes innovation as a combinatorial process (Schumpeter, 1934; Arthur, 2007), we argue that interactions between new technologies and established industries, along the development of the former, create conditions for new combinations between existing knowledge and the one being developed. These (re)combination processes may lead to the development of new innovative activities, providing firms in established industries with opportunities for diversification into more value-added businesses.

Corporate diversification has been described as a strategy that companies in industries that are declining or growing very slowly can use to pursue growth opportunities in other markets (Helfat & Heisenhard, 2002; Wiersema & Beck, 2017). The literature has shown that firms benefit from diversifying into businesses that are related to the ones in which they already operate – relatedness being understood as having "a common skill, resource, market, or purpose" (Rumelt, 1974:29) – since this enables existing resources or competences to be at least partly redeployed (Adner & Zemsky 2016; Luthge, 2020). This can be done both by entering into new markets based on the firm's existing resources; or introducing new products in its existing markets (Penrose, 1995).

However, the development of new products or the adjustment of existing ones to new applications will always entail a greater or lesser component of novelty that goes beyond a simple process of resource re-deployment, requiring firms to develop or access to new resources and competences. The establishment of collaborative relationships can be critical in achieving these goals, permitting to overcome the knowledge or financial constraints faced by firms from mature sectors (Hansen & Winther, 2014) and to bring together complementary competences and resources (Zeng et al, 2010). This is particularly the case when these processes are being driven by the application of new technologies, which will tend to be more distant from the firms (or even the sectors) knowledge bases (Boschma, 2005). But while relationships between established low-tech sectors and new technology-intensive ones can be critical for diversification processes (Hansen & Winther, 2014), the establishment of such relationships may not be easy, given the technological, organizational and cultural differences between them (Teixeira et al, 2008).

Technology-based firms have been found to often act as knowledge intermediaries towards established firms, through collaborative relationships in the context of research and innovation projects (Conceição et al, 2019). But difficulties may still emerge, particularly in the case of firms of more traditional sectors, which are likely to have a lower technological level and limited R&D experience (Acha & von Tunzelmann, 2004), and thus may experience some difficulties in absorbing the knowledge being developed in the projects and applying it to their business (Cohen & Levinthal, 1990).

At this level, a role can be played by a particular set of firms – knowledge intensive business services (KIBS) – which act as knowledge and know-how intermediaries in the innovation process, while simultaneously being innovators on their own right (Shearmur & Doloreux, 2017). In their interaction with their clients, KIBS mediate to sources of knowledge, information, know-how, markets and regulators, and also develop know-how, sometimes co-producing it with the client (Den Hertog, 2000). In this sense KIBS are both producers and carriers of new technology (Miles et al, 1995, 2018).

The KIBS category involves a variety of firms that are heterogeneous in knowledge bases and behaviour (Pina & Tether, 2016). One major distinction was made, in Miles et al (1995) pioneer work, between technology-based services (T-KIBS) and professional services (P-KIBS). In particular, new technology based KIBS are described as associated with emerging generic technologies or addressing generic problems requiring new technological solutions (e.g., environmental problems), their activities arising from the uncertainties surrounding the performance of new technologies (Miles et al, 1995).

Technology KIBS firms thus emerge as instrumental in the access and use of new technologies that are distant from the knowledge base of existing (manufacturing) sectors. However, this does not exclude a role for professional KIBS (e.g., specialized consultants) that can act as information intermediaries, especially in sectors populated by less technology-oriented firms, as well as support the development of organizational skills necessary for change (Santamaría et al, 2009). Similarly, it does not exclude the role played by product-oriented technology-based firms that operate within mature sectors, developing new products that add value to existing activities, sometimes in partnership with established firms. Indeed, it can be argued that is the combined activities of these different categories of knowledge-intensive companies that have the greatest potential to create transformative processes within mature sectors.

In the case of the Blue Economy, previous research (Sousa et al, 2020) has shown that a variety of sectors are exploiting new opportunities, including both established activities related to ocean (e.g., fisheries, ports) and new activities (e.g., biotechnology, marine energies). It also provided some early evidence of cross-fertilization between firms from different sectors and suggested that more technology intensive industries can play an important role in driving the exploitation of these opportunities.

Considering the above, the paper addresses the conditions in which interaction between new technologies and established activities can bring about change in mature sectors, thus contributing to their rejuvenation and revitalization. It proposes that: (i) inter-industrial relationships in the context of research and innovation projects can be a first step towards processes of knowledge combination that lead to the development of new products or their adaptation to new markets, driving diversification processes in established/mature sectors; (ii) technology-based firms – and in particular knowledge intensive business service firms – play a key role in these processes, as co-innovators and “translators” that bring knowledge related to new technologies and support their combination with business/market competences and (material) resources of established firms. Given the sectoral composition of the Blue Economy area and the strategic goals formulated to this area, an understanding of these processes can be critical to the more adequate implementation of policies aiming at its development.

3. Methodology

The paper adopts an exploratory approach, using a descriptive analysis. The first step of the empirical analysis aims at assessing the extent and structure of the inter-industrial relationships. It uses Social Network Analysis (SNA) to map the relationships established between new and existing industries in the context of research and innovation projects, in the Blue Economy field. In a second step, the nature of these collaborative relationships - namely the role played by firms from knowledge intensive service sectors - and their potential to induce revitalization processes are illustrated through a few cases, in areas selected by their relevance for the Portuguese economy.

To map the inter-industrial relationships, data was collected on two groups of projects in the Blue Economy area with the participation of Portuguese firms: 1) European projects funded by the Horizon 2020 programme; 2) national projects funded by the Portugal 2020 programme. For this purpose searches were conducted, using a series of keywords related with the ocean and with sea-related activities and industries, in the European CORDIS database and in three national sources: the database of the National Innovation Agency and the lists of funded projects provided by the Portugal 2020 and by the Fundo Azul programmes. As a result, 96 national projects and 72 European projects involving Portuguese firms were identified. These projects involved 149 Portuguese firms from 68 industrial sectors that are the object of the analysis.

To map the interactions between the industries involved in the projects, SNA was used. Each project is a 2-mode network, where the projects are the events and the participants are the actors. Since we are focusing on inter-industry relations between Portuguese partners, only firms were included in the analysis. It is considered that two sectors (represented by the Statistical Classification of Economic Activities - NACE Rev2 – at 6 digits) form a dyad if two Portuguese companies from these sectors are collaborating in the same project. Network diagrams were prepared using the NodeXL software, that was also used to perform SNA, namely to compute centrality measures.

The sectors identified were classified along two dimensions: the technological intensity; the relationship with the sea. Regarding the former we combined the EUROSTAT High-tech Classification of Manufacturing Industries (Eurostat, 2018), for the manufacturing sector; with Miles et al (1995, 2018) classification of knowledge-intensive business services. Table 1 presents the distribution of sectors along the various categories[1].

It should be pointed out that the fact that a sector has a generic classification does not mean that it extends to all the firms operating in it. Thus, technology-based firms may be in active sectors not classified as such. In order to have a better understanding of the position and roles of the technology-based firms we conducted an additional classification of firms, according to the activities they effectively perform, based on information from their webpages, technology directories and previous research. It was concluded that, while the vast majority of the 75 firms we identified as technology-based were KIBS (most of them T-KIBS, but also a few P-KIBS), some were found to be active in primary or manufacturing sectors. Among these firms, which we labelled product-based, a small set operated in sectors classified as low-tech (5 firms in fisheries and aquaculture and food manufacturing sectors) and medium low tech (2 firms in the shipbuilding sector).

Regarding the relationship with the sea, we used as basis the Portuguese Satellite Account for the Sea (SAS)[2] (INE & DGPM, 2016). Class codes totally included in the SAS were classified as “sea industries”. Those only partially or residually included in the SAS were classified as “non-sea industries”, even if some of the firms use sea resources or provide goods or services to activities that take place at sea. Table 1 also presents the distribution of the sectors along these two categories.

Table 1: Sectors by technology intensity and relation with the sea

Type of sector	Nº sectors	Nº Firms
A) Technological intensity		
Primary & Manufacturing sectors (1)		
HT – High technology	2	3
M-HT - Medium high technology	7	8
M-LT – Medium low technology	8	14
LT – Low technology	25	39
Service sectors (2)		
T-KIBS – Technology knowledge intensive business services	7	55
P-KIBS – Professional knowledge intensive business services	5	10
Non-KIS – Non knowledge intensive services	14	20
B) Relation with the sea		
Sea	14	31
Non-sea	54	118
Grand Total	**68**	**149**

Legend: (1) Eurostat (2018); (2) Miles et al (1995, 2018)

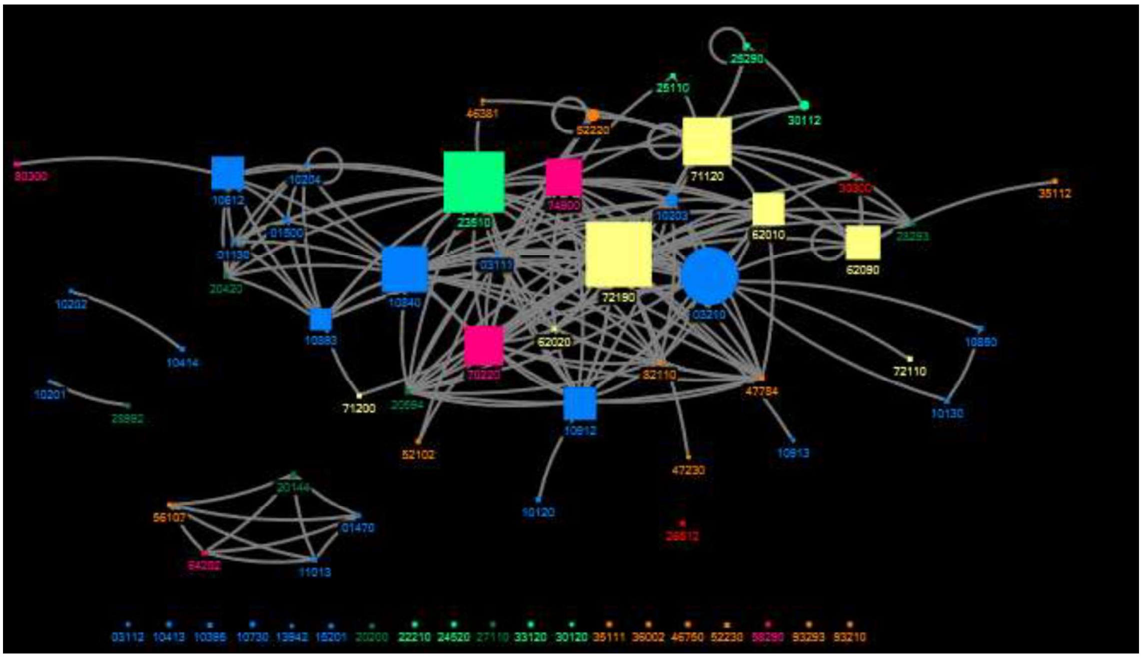
4. Results

4.1 Mapping the inter-industrial relationships

The network formed by the relationships between the sectors involved in the projects is presented in Figure 1. Table 2 presents the network centrality measures by type of sector. Degree centrality represents the activity of the sector in the network (i.e., the number of interactions it has in the projects) while the betweenness centrality captures the bridging role of the sectors (i.e., their positioning in linking other sectors that would be otherwise disconnected).

[1] A few sectors were not included in these classifications. Thus, we classified those in NACE section A (Agriculture, Forestry and Fishing) as Low Technology, and service sectors not included in the KIBS category as non-KIS services.

[2] Satellite Accounts are extensions of the central system of accounts, with additional information. In this case, the objective was to estimate the dimension and importance of the sea/ocean economy in the whole economy and to provide information on the production structure of the economic activities related to the sea.



Legend: *Shapes of the nodes*: Circles - Sea industries; Squares - Non-sea industries. *Colors of the nodes*: Blue - low tech; Light-green - medium-low tech; Dark-green - medium-high tech; Red - high tech; Yellow - T-KIBS; Pink - P-KIBS; Orange - non-KIS. *Size of the nodes* is proportional to the betweenness centrality.

Figure 1: Networks of inter-industrial relationships

Table 2: Network centrality measures by type of sectors

	Average Degree	Average Betweenness
Sea	4.9	9.457
Not Sea	5.3	12.993
LT	5.4	11.561
MLT	3.8	16.446
MHT	4.3	0
HT	2.5	0
Non KIS	2.9	0.360
P-KIBS	7.0	19.713
T-KIBS	11.3	44.257
Total Network	**5.2**	**12.264**

The data confirms the central role played in the network by KIBS sectors, in particular T-KIBS. The 72190 sector (R&D) occupies a central position and intermediates between other sectors, both low and high tech. In particular, it connects with and between sea-related sectors, low/medium-low technology sectors and technology/knowledge intensive ones. The strong connections with sea-industries such as fisheries and aquaculture or with food industries that are part of the sea value-chain can be explained by the high number of projects in which research-oriented firms apply biotechnology to the development of new products (food) or processes (aquaculture). Other T-KIBS sectors – 71120 (engineering) and 62010 & 62090 (ICT) - also play an intermediary role, although with a lower scope and with a less intense (direct) connection with the sea industries. The same can be said for P-KIBS involved in business or technical consultancy (70220 & 74900).

But the data also shows some dynamics that go beyond the one driven by KIBS. One low-tech sea sector (03210) has a very central position in the network. This centrality can be partly explained by the presence of product-oriented technology firms (e.g. operating in the microalgae business) that act simultaneously as innovators and as connectors to other sectors, in a similar vein to T-KIBS. Other sea industries are less visible, being connected to more central sectors through a small number of linkages.

The data equally shows a relatively high betweenness centrality of a low-tech non-sea sector (10840) concerned with food manufacture, and few other similar sectors also show some centrality, albeit lower. This reflects the dynamics of some sectors upstream in the value-chain, which are linking to and between downstream parts of the chain and knowledge-intensive firms.

Finally, the data shows that one medium-low technology sector (23510 - cement) presents a high betweenness centrality. A more detailed examination shown that the extensive relationships driven by this sector have a diverse origin, being based on environmental motivations: an energy intensive sector has developed longstanding relationships with microalgae producers, first to develop solutions for CO2 sequestration and later becoming more closely engaged in the actual micro-algae business, through a process of diversification with the creation of a new company.

4.2 Uncovering the role of technology-based firms in revitalization processes

In this section we look in greater detail into seven illustrative cases of projects, with a view to provide evidence on collaborative activities between firms which are inducing processes of change that can have a transformative impact on established Blue Economy sectors. For this we consider sectors that are important for the Portuguese economy and in which there is evidence of relevant research and innovation collaborative activities.

Table 3 shows the weight of the sectors that compose the Blue Economy according to the Satellite Account for the Sea (SAS), based in two indicators – gross value added (GVA) and employment in the period 2010-2013 (average values) and in 2017.

Table 3: Satellite Account for the Sea – evolution of GVA and employment (by group)

Group	Gross value added (10^6 euros)		Employment - full-time equivalent (N.º)	
	2010-2013	2017	2010-2013	2017
1. Fisheries, aquaculture, processing, wholesale, retail	1 203	1 652	62 414	62 257
2. Non-living marine resources	49	58	2 333	1 720
3. Ports, transports and logistics	676	684	15 086	12 173
4. Recreation, sports, culture and tourism	1 660	2 951	45 950	78 195
5. Shipbuilding, maintenance and repair	119	154	4 404	4 883
6. Maritime equipment	159	205	9 028	6 955
7. Infrastructures and maritime works	65	286	2 850	6 455
8. Maritime services	741	691	18 615	16 247
9. New uses and resources of the ocean	7	8	88	351
Total of Ocean Satellite Account (OSA)	**4 679**	**6 688**	**160 768**	**189 236**
OSA / National economy (%)	**3,1%**	**3,9%**	**3,6%**	**4,1%**

The Table shows, first of all, that the weight of the Blue Economy in the national economy has increased between these two periods, reaching 3.9% of the national GVA and 4.1% of employment in 2017 (DGPM, 2019). Overall, the field registered an increase of 43% in GVA and 18% in employment.

Considering the individual groups of sectors, 'recreation, sports, culture and tourism' and 'fisheries, aquaculture, processing, wholesale, and retail of its products' have the greatest weight in terms of both GVA and employment, followed at a certain distance by 'maritime services' and 'ports, transports and logistics'. But we observe a diverse evolution of these groups between the two periods. There is a strong increase in both GVA and employment in 'recreation, sports, culture and tourism', which reflects the strong expansion of tourism activities. There is also an increase in the GVA of 'fisheries, aquaculture, processing, wholesale and retail of its products' (37%) but the employment remains unchanged, revealing an increase in productivity. In the case of and 'ports, transports and logistics' there is a decline in employment, associated with a very limited increase in GVA pointing to stagnation. In the case of 'maritime services' there is a decline in both GVA and employment.

Three other groups, with a lower weight - 'shipbuilding, maintenance and repair', 'infrastructures and maritime works' and 'new uses and resources of the ocean' – show a positive evolution, increasing in both GVA and employment. Increase in GVA is particularly marked in 'infrastructures and maritime works' that more than tripled; while in 'new uses and resources of the ocean' employment has tripled.

Among the groups identified above, we chose to focus on three. First, the 'fisheries, aquaculture, processing, wholesale, and retail of its products' area, because of its weight in the Blue Economy and the potential for revitalization represented by the high number of research and innovation projects targeting it. In fact, almost half of the research and innovation projects identified are in the "living resources" field, encompassing both projects whose activity is explicitly on fisheries or aquaculture (44%) and biotechnology projects that aim at the development or the sustainability of the value-chain based on marine living resources (56%) (Sousa et al, 2020).

Second the 'ports, transports and logistics', because this is a strategic area that can have a central role in the development of the Blue Economy but appears to experience stagnation and thus can benefit strongly from activities that promote its revitalization. This is also one of the areas with a greater incidence of projects, which indicates the presence of actions towards its upgrading (Sousa et al, 2020).

Finally, we focus on the 'new uses and resources of the ocean' because of the growth potential it appears to show, and also because this corresponds to an area in which the development of new technologies can be accelerated through the mobilization of resources and competences from established sectors - including growing sectors such as infrastructures and maritime works, stagnating ones such as ports, or recovering ones such as shipbuilding (Makitie et al, 2018), thus opening diversification opportunities for them. This is namely the case of one of the main areas included in this group, marine renewable energies, which is the second in terms of incidence of projects, which denotes an effective interest in its development.

Thus, while the first two areas encompass sectors in which new transversal technologies can have an revitalization role, adding value through product development, increasing efficiency and safety and improving sustainability; in the third one it is the actual development of an emerging sector that can act as driver of change to established ones that supply complementary resources and competences.

Tables 4 to 6 present some illustrative cases of the role that can be played by technology-based firms in these areas. When analyzing these cases particular attention will be given to three main aspects: i) the nature of partnerships; ii) the type of companies involved; iii) the contribution of the technology firms.

In the 'fisheries, aquaculture, processing' area (Table 4) we selected three projects that are representative of different approaches adopted in this area. Project GAIN links a T-KIBS active in marine biotechnology with a seafood farming company, to improve the efficiency and sustainability of the processes. Project ALGAVALOR links two product-oriented biotechnology firms (NACEs 10840; 10893), active in microalgae research and production, with a group of established companies from various sectors, to produce microalgae at industrial level and apply them to develop new food products, in a project also encompassing environmental concerns. A different approach is followed in project CAVIAR that brings together three technology companies, two KIBS (active in engineering and in research) and one product-oriented (10893), to add value to an underused marine resource (sea urchin gonads), creating a completely new line of business in this sector, that can be subsequently explored by the firms.

Moving to the 'ports, transports and logistics' area, we selected two illustrative cases, both showing partnerships between established and technology-based firms, but involving different types of latter (Table 5). Project GISAMP joins a P-KIBS with a group of port administration and operator companies to conduct actions (training, consultancy, technical assistance) towards the improvement of the management and safety of port infrastructures. NAVSAFETY moves further and joins a T-KIBS with a port administration company to develop monitoring systems and instruments for navigation safety in port areas. In both cases KIBS firms are contributing to upgrade the quality of port activities, but in the second case the results can also lead to the development of innovative solutions with market potential.

Finally, we turn to the activities concerning the new uses of the ocean (Table 6). Project OIPS joins a T-KIBS and an energy utility in the development of activities in a new area – floating offshore wind – which can contribute to the diversification of the energy incumbent into a new renewable energy business. At a broader level, NESSIE joins a T-KIBS active in the new materials field, with two established companies – active in shipbuilding and in metalwork – in the development of complex platforms for inspection and monitoring of marine infrastructures in diverse areas (energy, security, sea observation), thus opening business opportunities based in more complex/value-added products with a broad range of applications.

Table 4: Cases in area 'fisheries, aquaculture, processing'

Projects	Type of partnership	Technology Firms		Established Firms	
		Firm (NACE)	Area	Firm (NACE)	Area
GAIN					
Key goals: ecological intensification aquaculture (feeds, cultivation process, farm management	T-KIBS + Established	SPAROS (72190)	Biotech	Sagremarisco (47230)	Fish retail trade
ALGAVALOR					
Key goals: application of biotech to microalgae production and their use to develop new food products; environment protection	Tech product-oriented + Established	Necton (10840) Allmicroalgae (10893)	Biotech (microalgae) Biotech (microalgae)	Cimentos Maceira e Pataias (23510) Vaisa - Agricultura Intensiva (1130) Valorgado - Agricultura e Pecuária (1500) Empresa Figueirense de Pesca (10204) Narciso Dias & Filhos (10204) Ernesto Morgado (10612) Castelbel - Artigos de Beleza (20420)	Concrete Agro Agro Fish processing Fish processing Food Cosmetics
CAVIAR					
Key goals: application of biotech to add value to marine resources (sea urchin)	T-KIBS + Tech product-oriented	Ínclita Seaweed Solutions (10893) SENSE TEST (71200) Riasearch (72190)	Biotech (seaweed) Food Biotech (aquaculture)		

Table 5: Cases in area 'ports, transports and logistics'

Project	Type of partnership	Technology Firms		Established Firms	
		Firm (NACE)	Area	Firm (NACE)	Area
GISAMP					
Key goals: port security & efficiency; risk management in supply chains	T-KIBS +Established	Qualiseg (70220)	ICT	APA (52220) APDL (52220) APS (52220) Gaslink (52102)	Port administration Port Infrastructures
NAVSAFETY					
Key goals: ICT and instrumentation for maintenance and safety of port infrastructures	P-KIBS + Established	Simbiente (71120)	Environmental engineering	APFF (52220)	Port administration

Table 6: Cases in area 'new uses and resources of the sea'

Project	Type of partnership	Technology Firms		Established Firms	
		Firm (NACE)	Area	Firm (NACE)	Area
OIPS					
Key goals: floating platform combining offshore wind energy & aquaculture	T-KIBS + Established	Innovakeme (62090)	Marine energy	Empresa de Electricidade da Madeira (35112)	Energy
NESSIE					
Key goals: platforms for inspection/monitoring of marine infrastructures (e.g. energy, security)	T-KIBS + Established	Composite Solutions (71120)	Materials	A. Silva Matos (25290)	Metalwork
				Antartic Module Yard (25290)	Shipbuilding

It should be noticed that all but one of these projects also involve universities and/or public research organizations that either bring S&T knowledge in the same fields as technology firms or combine it with complementary knowledge in other fields. A good example of the latter is the NESSIE project where the materials knowledge of the T-KIBS is complemented with the knowledge of the partner research centre in underwater robotics and instrumentation. Projects also frequently include government agencies or collective organizations that can have an additional role in facilitating the interaction between the different partners or in the subsequent transformation of project results into actual businesses.

Despite the variety of situations, in terms of partner combinations and final goal of the activities performed (and also possibly in terms of actual contribution and benefits of each partner, whose assessment would require additional research) there is a common point to all these projects: the new technologies are being deployed in order to add value to the receiving sectors, improving the conditions in which their activities are being performed and often opening new product innovation opportunities, thus creating pre-conditions for product or market diversification.

5. Conclusions

The paper addressed the conditions in which inter-industrial relationships between new and established industries can contribute to the economic revitalization of the latter. For this purpose it conducted an empirical analysis of the relationships established by Portuguese firms in the context of research and innovation projects in the field of the Blue Economy. This is an area with a strong and increasing weight in the Portuguese economy, but characterized by diverse sectoral dynamics: some sectors are growing; others are stagnating, while at the same time, new activities are emerging that often have a transversal nature. This makes it an interesting setting to investigate the diverse effects of inter-sectoral interactions.

The research found some evidence of economic revitalization related to the development and implementation of new transversal technologies in the context of inter-industry collaboration networks. In these networks, technology-based firms - and particularly knowledge intensive business firms - undertake a vital role in connecting different types of firms and in combining the competences and resources from established sectors with new technologies.

These results are relevant to policies that aim to promote industrial transformation, in particular the revitalization of mature industries experiencing stagnation or decline, which became especially critical in the post-pandemic situation. They point to the need of a greater directionality of innovation policies (Mazzucato, 2018) and suggest that a potentially fruitful direction for these policies concerns the establishment or strengthening of inter-sectoral relationships between established and new industries, which can support increases in efficiency and sustainability, as well as create conditions for value-added diversification.

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