

Article

A Differentiation Framework for Maritime Clusters: Comparisons across Europe

Pedro Monteiro ^{1,*}, Teresa de Noronha ² and Paulo Neto ³

¹ Research Centre for Spatial and Organizational Dynamics, University of Algarve, and Regional Directorate of Agriculture and Fisheries of the Algarve Region, Braciais–Patação, Faro 8001-904, Portugal

² Faculty of Economics and Research Centre for Spatial and Organizational Dynamics, University of Algarve, Centro de Investigação sobre o Espaço e as Organizações, Edf. 9 Universidade do Algarve, Campus de Gambelas, Faro 8005-139, Portugal; E-Mail: mtvaz@ualg.pt

³ Economics Department and Center for Advanced Studies in Management and Economics, Department of Economics, University of Évora, Largo dos Colegiais 2, Évora 7000-803, Portugal; E-Mail: neto@uevora.pt

* Author to whom correspondence should be addressed; E-Mail: jpvmonteiro@gmail.com; Tel.: +351-289-870-700; Fax: +351-289-816-003.

Received: 30 August 2013 / Accepted: 5 September 2013 / Published: 24 September 2013

Abstract: The purpose of this paper is to point out some of the main characteristics and critical factors for success that can substantiate the proposal of a differentiation framework for maritime clusters. We conduct a benchmarking analysis intended to distinguish the most relevant aspects which can or should be observed in these types of clusters, applied to the following countries: Spain (Basque Country), Germany (Lander of Schleswig-Holstein), the Netherlands and Norway. The differentiation factors involve agglomeration economies and endogenous conditions derived from geographic proximity, essential for lowering transaction costs, strengthening the leverage of public/private cooperation through centres of maritime excellence, at the same time providing an adequate local environment that favours positive interactions between the different maritime industries and actors. The main results arising from this article are presented through a reconceptualisation of Porter's Diamond framework for diagnosing the competitiveness of maritime clusters.

Keywords: maritime clusters; innovation; knowledge networking; Porter's Diamond

1. Introduction

The European maritime cluster has a strong position in the maritime world. The following examples substantiate this claim [1]:

- (1) European ports handle almost 25% of world seaborne trade, its ship owners control almost 40% of the world fleet, and Europe has been the region with the highest global shipbuilding turnover for most of the last decade;
- (2) Europe is world's number one tourist destination with coastal tourism being one of its main attraction pools;
- (3) European yacht builders produce 60% of the mega yachts;
- (4) European dredging companies have 80% market share of the open market;
- (5) 40% of the oil and 60% of the gas consumed in Europe is drilled offshore;
- (6) Europeans dominate the market for renewable offshore energy;
- (7) European services, maritime research, inland shipping, fisheries and Navy are world leading sectors.

Seas around Europe provide a range of energy transport routes, via shipping, submarine pipeline networks, and electricity interconnectors. The sea biosphere (particularly from the deep sea) and its correlation with "Blue biotechnology" offer a great deal of potential revenues, through new products that can be obtained with the exploitation of our rich marine biodiversity. It offers long-term potential to many industrial sectors from aquaculture to healthcare and from cosmetics to food products, once an estimated 80% of the world's living organisms are found in aquatic ecosystems.

The current use of coastal areas is multifaceted and highly competitive and a source of use conflicts for space allocation and resource depletion. This situation has highlighted the need for sufficient planning and regulations to optimize the management of the resources within a multiuse context.

Conflicts over the use of marine and coastal space tend to fall into two broad categories ([2], pp. 327–328), the first category concerns to areas with existing regulated, restricted or prohibited access such as: major shipping routes, military exercise grounds, major structures, sub-sea cables or pipelines, and marine protected areas for fisheries management or marine conservation. The second one refers to areas with conflicting uses exist such as: commercial and recreational fishing grounds, resource extraction areas, tourism and non-consumptive recreational areas, archaeological sites such shipwrecks, and those with cultural significance.

The environmental problems that dominate the present day are the result of increasing pressure on natural resources. Therefore, it is essential to understand what are the reasons why individuals and society make choices that lead to the depletion of natural resources and what are the guidelines that could/should be used to promote their sustainable management. Despite all the efforts to improve environmental quality of coasts and seas around the world, degradation of ocean environments has continued.

As well, the lack of an integrated approach when using this shared resource has often caused conflict among economic, environmental and social objectives. Management of ocean resources in a global, sustained and integrated fashion has remained elusive, despite several international agreements and initiatives. In the debate over the economic scarcity of natural resources, one significant change in recent years has been a greater focus on the ecosystem services and the resource amenities yielded by natural environments. The general conclusion extracted from Krautkraemer [3] is that technological

progress has ameliorated the scarcity of natural resource commodities; but resource amenities have become scarcer and it is unlikely that technology alone can remedy that. This configures the absolute need for a long-term strategy to support sustainable growth in the maritime sector as a whole, in what has been recently designated for instance by the EU as “Blue growth” strategy.

Around the world in recent decades, awareness has emerged that the management and governance of the ocean, coastal zones and human activities associated with it, should be addressed at an ecosystem approach, of sustainable development, based on a comprehensive view, not sectoral but integrated, towards [4]: “The use of windows of opportunity for the development of new activities and uses of ocean and coastal areas, minimizing, in advance, potential conflicts of use between the various users and activities that make use of the sea to fulfil its objectives or as a resource, such as tourism, recreation and leisure, water sports, sea and inland cruises, shipping, dredging and coastal protection works, nature conservation and biodiversity, underwater archaeology, recreational and commercial fishing, aquaculture, renewable energy, exploration and extraction of geological resources, the passage of cables, pipelines and broadcasters, commercial and fishing ports, marinas, scientific research and technology, engineering and shipbuilding, military exercises, the use of genetic resources, inter alia, by biotechnology.”

As expressed by SaeR [5], among the scientific community there is an almost unanimous opinion as to the advantage for the use of a cluster approach, embodied through the concept of the “Hypercluster of the Sea”, which encompasses a complex of activities ranging from Tourism and Leisure to Logistics and Maritime Transport, Fisheries and Aquaculture, Naval Construction and Repair, Related and Supporting Services, to Research and Development. This way of approaching the issues from the sea, being systemic, requires a global vision and a holistic and interactive performance in the search for strategic solutions to increase the efficient use and value added generated by the exploitation of resources of the Sea. A maritime cluster will help to achieve a better articulation, will maximize the use of synergies and economies of scale, while it will contribute to build a sustainable and integrated view of the sea, of its resources and of the various activities associated with it.

Although rarely addressed among the various authors considered in the literature review, our intention is to find out what are the distinctive factors to consider in a targeted cluster approach for the maritime economy. We want to focus on what are the critical factors that influence the creation, sustainable development and resilience of successful maritime clusters, and how their respective competitiveness factors are greatly enhanced by multi-sectoral clustering processes.

The goal of this study is to point out some of the main characteristics and critical factors for success that can substantiate the proposal of a differentiation framework for maritime clusters. We conduct a benchmarking analysis intended to distinguish the most relevant aspects which can or should be observed in these types of clusters, applied to the following countries: Spain (Basque Country) [6–8], Germany (Lander of Schleswig-Holstein) [9,10], the Netherlands [11–13] and Norway [11,13,14]. The differentiation factors are considered to be essential regarding the success and long term resilience of maritime clusters, involving agglomeration economies and endogenous conditions derived from geographic proximity, essential for lowering transaction costs, strengthening the leverage of public/private cooperation through centres of maritime excellence, at the same time providing an adequate local environment that favours positive interactions between the different maritime industries and actors.

The main results arising from this article are presented through a reconceptualization of Porter's Diamond model for diagnosing the competitiveness of maritime clusters. The main contribution of Porter's theory has been the outcome of four interlinked advanced factors (the factor conditions, the demand conditions, the related and supportive industries and the government) in and between companies within clusters, which can be influenced in a pro-active way by government. To substantiate the proposal of a differentiation framework for maritime clusters we chose Porter's Diamond model, because it allows us to evaluate how these factors interact with each other to form conditions where innovation and competitiveness occurs.

The paper is organized as follows: after this introductory section, the next Section 2 elaborates on the objectives pursued and the methodology chosen to conduct the data collection and treatment; Section 3 presents the current literature review related to the concept and nature of clusters, while Section 4 talks about their relation with innovation and knowledge networking; Section 5 discusses the data collected through benchmarking and summarises the observations made using a matrix built over the seven cluster key dimensions proposed in Andersson *et al.* [15]; finally, Section 6 reports the main results and supervening discussion arising from this article in terms of the distinctive factors that influence the creation, sustainable development and resilience of successful maritime clusters. Those conclusions underlie the proposal for a re-adaptation of Porter's Diamond model of national/regional competitiveness for the case of maritime clusters.

2. Objectives and Methodology

Along this article, we will assume our solid conviction that innovation and networking processes are the primordial corner stone of successful long-term maritime cluster policies, *i.e.*, the ability to innovate and the collective production and appropriation of knowledge are the most important factors for the survival, competitiveness and economic growth in maritime clusters. From a more evolutionist perspective, we will therefore attempt in this paper to stress the following idea:

A complex phenomenon such as innovative performance needs explaining in terms of a multifarious set of factors. The level and character of competition within maritime clusters is highly dependent upon the existence of formal networks of economic, social and environmental actors that constitute an aggregation of interactive, mutually interdependent economic actors connected to the sea, as expressed in Salvador [16].

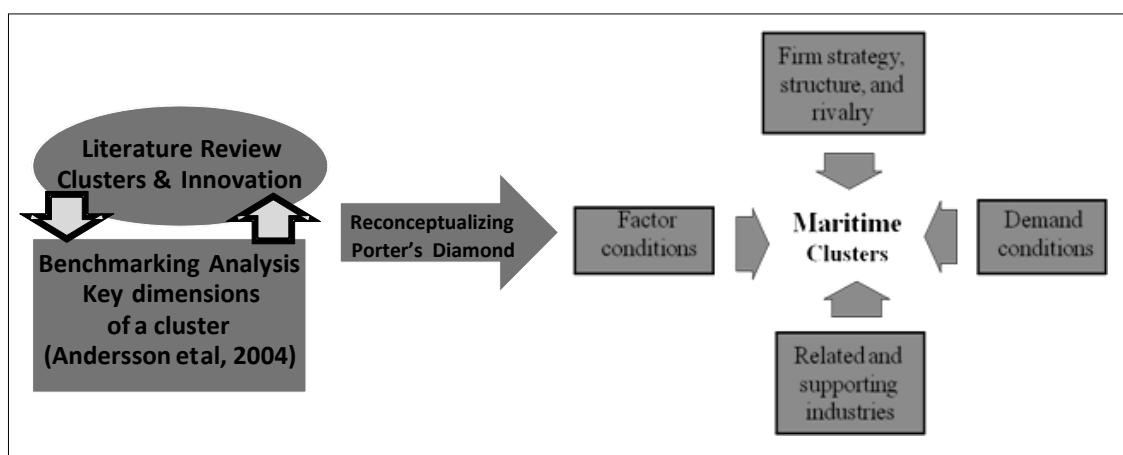
To do so and subsequently to create a literature review focused on the cluster nature and on the relation of clusters with innovation and networking processes, we will conduct an exercise intended to distinguish what are the main features and critical factors for success behind successful European maritime clusters. As a reference framework for this benchmarking, we will use the following seven key dimensions proposed in Andersson *et al.* [15]: (i) Geographical concentration; (ii) Specialisation; (iii) Multiple actors; (iv) Competition and co-operation; (v) Critical mass; (vi) The cluster life cycle; and (vii) Innovation, to measure their maturity and development level. This set of observations then will allow us to reconceptualise Porter's Diamond framework for diagnosing the competitiveness of maritime clusters.

To understand the dynamics of maritime clusters, a conceptual model is proposed, which highlights the main forces driving a maritime cluster as well as its underlying mechanism. This paper describes new methodology techniques for analysing the competitiveness of maritime clusters, using a modification

of the Porter Diamond Model (see Figure 1). Porter's Competitive Advantage of Nations [17] introduces his diamond model of competitiveness through four broad drivers that shape the environment in which firms and regions compete for business:

- Factor conditions, which include the skills, resources, technology, and infrastructure necessary to create competition in a given industry or cluster;
- Demand conditions, which include the nature of local and overseas demand for industry products and services;
- Related and supporting industries, where the presence or absence of suppliers and distributors in support of industry sectors or clusters will determine competitiveness;
- Firm strategy, structure, and rivalry, which relate to conditions in a nation governing how companies are created, organized, and managed and the nature of domestic rivalry.

Figure 1. Objectives and methodology recruited for the paper.



Source: Authors.

Porter identified two other important factors that affect competitive advantage of firms: chance and the role of government. Chance relates to events or occurrences that have little to do with a country's circumstances, but can be influenced by individuals. Governments can have significant role in aiding competitive advantage, especially through public policies which are favourable to investment and profit performance.

3. The Evolutionary Concept of Clusters

Porter [18] gives the following definition for clusters: "Clusters are geographic concentrations of interconnected companies, specialized suppliers, service providers, firms in related industries, and associated institutions (for example, universities, standard agencies, and trade associations) in particular fields that compete but also cooperate."

Clusters are characterized by the following commonalities [19,20]:

- Forward and backward linkages between firms
- Information exchange between firms and other cluster members
- Institutional infrastructure supporting the activities of the cluster
- A social cultural identity with common values

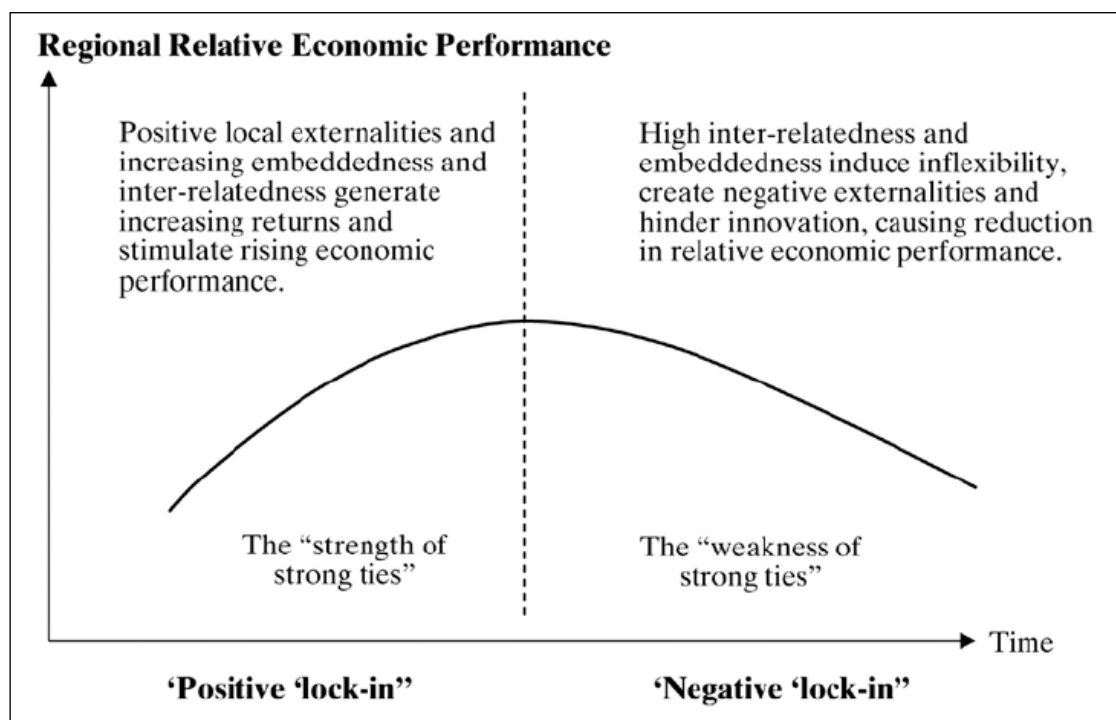
- Shared focus
- Entrepreneurship attitude, aiming at value-creation and innovation
- Most important is agglomeration, being, either, geographic, economic, cultural or sectorial.

When clusters are defined as groups of firms interconnected through trade and other kinds of interaction and interdependencies, it becomes important to recognize that they contain both horizontal and vertical linkages (Maskell apud Sornn-Friese [21]). Horizontal linkages are relationships between competing and sporadically cooperating rival firms operating at the same stage of the value chain, while vertical, or user-producer, linkages are relationships between complementary firms at different stages of the value chain (Gemser apud Sornn-Friese [21]). Malecki and Poehling [22] have given a very valuable review of the literature on this issue. They observe a variety of network configurations, such as suppliers or customer networks, local networks of neighbouring firms, professional networks and knowledge networks, which all may contribute to a better entrepreneurial performance.

In growing functional regions, the location of households and firms form a self reinforcing dynamic process, *i.e.*, a process with positive feedbacks. Over time, the (slow) formation of regional infrastructure affects the process by gradually building up the basic conditions for the household milieu and the economic milieu of firms [23]. Neto [24] suggests that network strategies and the affirmation of the functional territories modify the organization and the spatial and economic interrelationships of sectors and their organizations, as well as the economic specialization of the territories, by this means reshaping the comparative and competitive inter-territorial advantages. Porter's theory states that a cluster is the manifestation of the "diamond" model at work, in which proximity (understood as the placement of companies, customers and suppliers) amplifies all the existing pressures to innovate and improve economic performance. Porter [17] also discusses the role of opportunity and of the state within the diamond's vertices (competitiveness factors). Inside the cluster and its supporting forces, the resulting benefits (e.g., information and innovation) flow in several directions [17], allowing, thus, boosting growth, encouraging competition and innovation in related support companies. Successful clusters have also significantly increased their global reach, attracting people, technology and investments, serving global markets, and connecting with other regional clusters that provide complementary activities in global value chains [25].

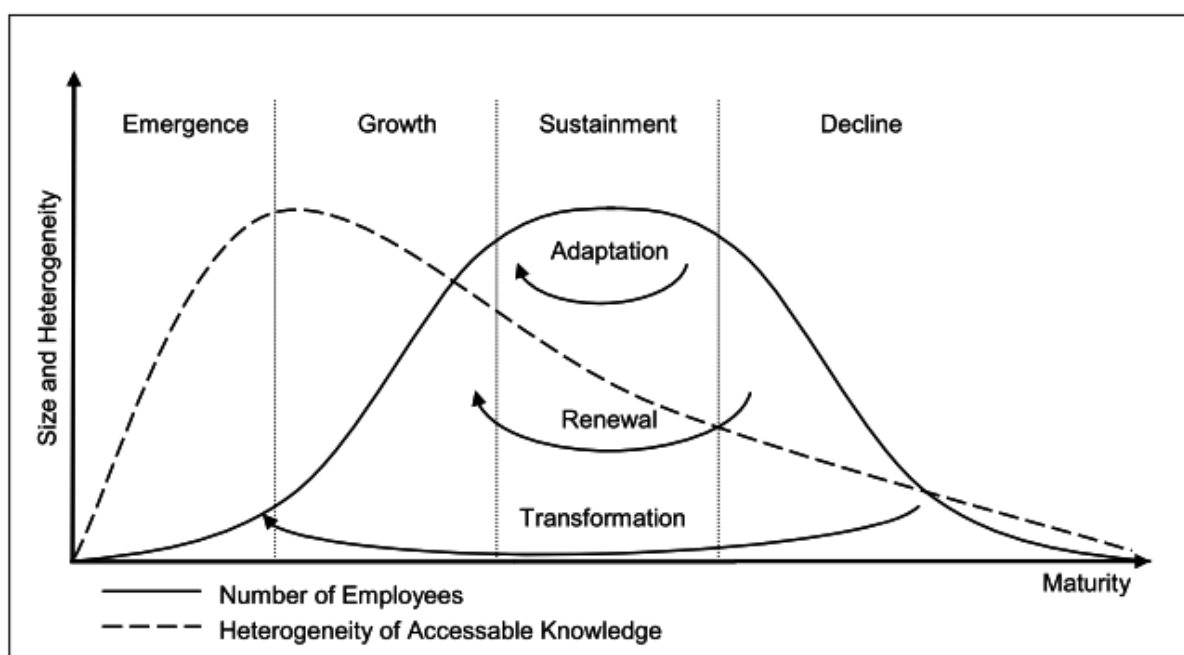
A growing literature looks at the life cycle of clusters (Bergmann apud Ketels [26]). Clusters often seem to follow an s-shaped development path. After an (often long) phase of slow gestation a cluster reaches a size where cluster effects set in and growth accelerates. This growth then becomes self-reinforcing; cluster effects reach their full scale and growth explodes. Eventually, growth moderates as the cluster reaches its market potential and congestion effects become more relevant. Some clusters then manage to reinvent themselves, finding a new market or technology to ignite a next phase of cluster dynamisms. Others, however, get locked into existing technology and eventually shrink, as their markets disappear or other locations develop more dynamism (Audretsch *et al.* apud Ketels [26]). Martin and Sunley apud Holte and Moen [27] describe how the positive factors turn into a negative lock-in with inflexibility and reduced innovation ability as illustrated in Figure 2.

Figure 2. Illustrating development paths.



Source: From Holte and Moen [27].

According to Menzel and Fornahl [28], the connections between quantitative and qualitative development of the cluster indicate that its heterogeneity of knowledge is the foundation of its development. The cluster declines if its heterogeneity cannot be sustained. If the heterogeneity increases again, the cluster moves “back” in the cycle and enters a new growth stage. This increase in heterogeneity can be incremental, e.g., the integration of new knowledge from the respective technological trajectory into the cluster. Examples of this are clusters which manage to maintain their heterogeneity by incrementally adapting to a changing environment. However, the increase of heterogeneity can also be of a more radical nature. Clusters can renew themselves by integrating new technologies, like the accordion cluster in Marche/Italy whose companies use electronics in their previously traditional musical instruments (Tappi apud Menzel and Fornahl [28]). The step back can be larger, when clusters are transformed and move into completely new fields. Such a shift took place in the declining coal and steel complex of the Ruhr Area towards environmental technologies (Grabher apud Menzel and Fornahl [28]) or in the Glasgow-Edinburgh Corridor (GEC). In the latter, as observed by Aziz *et al.* [29], with the adoption of cluster oriented policies by the authorities, the corridor as a cluster had been showing signs of being at the “Transformation” stage with the emergence of a number of key sectors - software development, nanotechnology, green energy, biotechnology, life sciences and creative industries. Additionally, the cluster can increase its heterogeneity by changing its developmental rationale, for example from production to the local organisation of global value chains as can be observed in some successful European maritime clusters (e.g., Norway and Holland), forced to externalise their value chains when facing severe foreign competition. Therefore, the development of the cluster is not a deterministic move from the left to the right, but a steady oscillation between the left and right sides of the Figure 3.

Figure 3. Quantitative and Qualitative Dimensions of the Cluster Life Cycle.

Source: Menzel and Fornahl [28].

4. Clusters as Motors of the Dynamic System of Innovation

An endeavor to make some differentiation of a maritime cluster, as opposed to a “cluster of economic activities mainly based on land”, may reside in the maritime cluster definition provided under the project “Europe of the Sea” [10]: “...a network of firms, research, development and innovation (RDI) units and training organisations (universities, specialized schools, etc.), sometimes supported by national or local authorities, which co-operate with the aim of technology innovation and of increasing maritime industry’s performance...”.

Hakanson [30] posits a model of cluster dynamics emphasizing two mutually interdependent processes: the concentration of specialized and complementary epistemic communities, and entrepreneurship and a high rate of new firm formation, which in particular stresses the role of knowledge in industry clusters.

Clusters are argued to have a positive impact on innovation due, among others, to knowledge spillovers, labour market pooling and competitive pressure. When comparing the general survey on innovative firms presented in the Innobarometer 2004 with the 2006 Innobarometer dedicated to “Cluster’s role in facilitating innovation in Europe”, both published by the European Commission, there are evidences pointing to the fact that clustering may foster more efficiently firm-level innovation. The data collected show that firms within clusters did more market research than firms located outside clusters (53% vs. 33%) and are twice more likely to cooperate with universities, research institutes or other firms in innovative activities (41% vs. 20%). They also registered more patents (29% vs. 12%), introduced more innovative products (78% vs. 74%) and introduced new or significantly improved production technology (63% vs. 56%).

The role of geographical proximity has been discussed in the literature concerning regional innovation systems, as well as the related with knowledge spillovers. The proponents of the view that

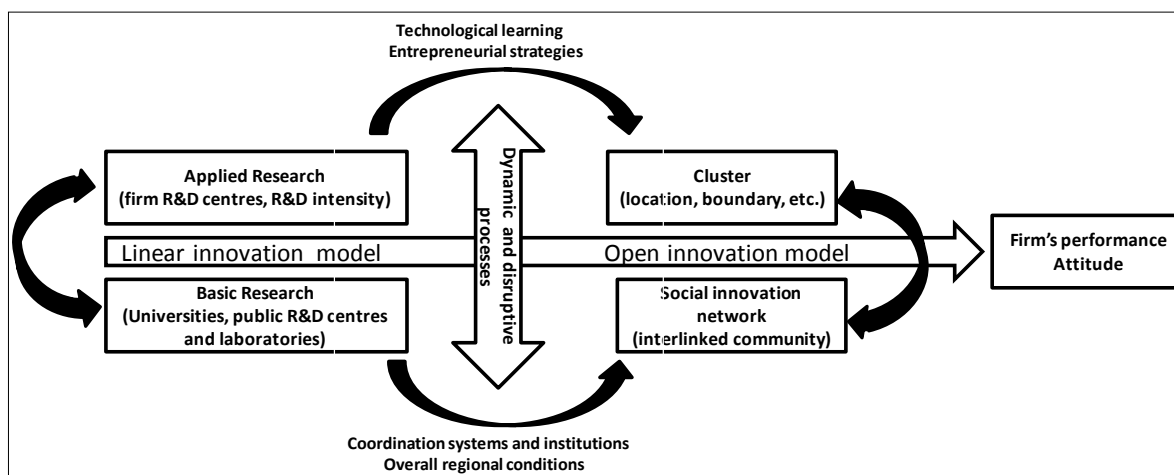
proximity offers innovation advantages in itself, begins in relatively recent times with Jaffe *et al.* [31]. The argument here was that RDI in particular constitutes a public good in locations where it concentrates and that this is sufficient to cause firms to concentrate in proximity to such knowledge spillover opportunities to access them as free goods in advance of competitors. Innovation and entrepreneurial behaviour are as consequence, heavily impacted or influenced by proximity conditions. If the entrepreneurial character of an individual agent is defined by the nexus between himself and an opportunity, then, what defines this nexus is how the individual appropriates the opportunity gain he aims at [32]. Also Hindle [33] refers that from the perspective of the practicing entrepreneur, the notion of evaluation culminates in the design of what needs to be done to convert a possible opportunity into some kind of blueprint for action. Additionally, market forces tend to concentrate investments in prosperous areas which offer better access to infrastructure and human capital, lower risks and better access to markets [34].

In this process, clusters have become increasingly specialised and increasingly connected with other clusters providing complementary activities. Successful clusters have also significantly increased their global reach—attracting people, technology and investments, serving global markets, and connecting with other regional clusters that provide complementary activities in global value chains [25].

Economic development results from discontinuous internal changes by economic innovations that originate from within the economic system, pinpointing major industrial disruptions which fuel business cycle fluctuations (Schumpeter apud Backhaus [35]). A useful concept in this regard is the “triple helix” [36–39], which holds that innovation networks in clusters depends upon academic and research institutions (Academia); companies, capital and entrepreneurship (Private Sector); as well as favourable framework conditions (Government). Arguing that the triple helix model is not enough to sustain long-term innovative processes, several authors defend the introduction of a fourth helix (Civil Society) to stress its importance in the knowledge creation process [40]. Cluster organizations and forums that facilitate the networked collaborations are also frequently highlighted as instrumental in clusters. However, at the basis of clustering is the interaction that occurs among businesses and people as part of regular work life. It is the creation of linked relations, which create cluster benefits. On the perspective presented at DG Enterprise and Industry [41], innovation is increasingly characterised as an open process, in which many different actors—companies, customers, investors, universities, and other organisations—cooperate in a complex ways. Ideas move across institutional boundaries more frequently. From a policy perspective the innovation system approach draws attention to the behavior of local actors with respect to three key elements in the innovation process: learning, linkage and investment ([42], p. 18). The subsequent demanding endeavour to combine, in the production chain, innovation with the coordination capacity of organizations, presents much more than a theoretical challenge, and rather a social reshaping [43]. Additionally, Noronha Vaz *et al.* [44] stressed that the transition from a closed regional environment to an open interregional system demands an evolution of economic activity from simple forms of activity branches into complex technological regimes. In such a dynamic system, technological learning, entrepreneurial strategies, coordination systems and institutions and overall regional conditions, are factors that determine firm attitudes to innovation. The traditional linear model of innovation with clearly assigned roles for basic research at the university, and applied research in a company RDI centre, is no longer relevant. Consequently, it is no longer so much the co-location of innovation stakeholders that counts as the

nature and intensity of their “connectivity” and the fact of belonging to the same social innovation network or “interlinked community” [45]. The main features of this changing paradigm are described below (Figure 4).

Figure 4. The changing paradigm.



Source: Authors, based on Amin and Cohendet [45] and Noronha Vaz *et al.* [44]

5. Benchmarking Analysis

For the purpose of conducting a strategic benchmarking analysis taken as relevant for the context of the present article, we present the following four successful examples of European maritime clusters: two regional clusters (the Basque Country and the Lander of Schleswig-Holstein) and two national clusters resulting from initiative bottom-up and top-down (the Netherlands and Norway). These four cases were selected among several other possibilities, because they constitute different approaches towards a successful maritime cluster strategy in terms of: top-down vs. bottom-up cluster initiatives, national vs. regional amplitude, degrees of specialization and the assumed cluster enablers.

This benchmarking analysis has three main objectives: firstly, to measure and compare the performance of four different European maritime cluster organisations; secondly, to show the main characteristics and differentiation aspects between them; and finally to increase our level of knowledge through the use of a data measurement tool with both strategic and operational relevance for the purpose of the current paper.

Following the general presentation of the main characteristics and drivers underlying each one of the European maritime clusters selected for this benchmarking analysis, the information for each case (quantitative and qualitative data) is organized and an evaluation of their current status is carried out in relation to seven cluster enablers proposed in the work of Andersson *et al.* [15].

Those main elements of clusters, commonly found in the literature, are driving forces and determinants of success [15]. That is not to say that all these elements need to be present, or should be pushed for, in specific cluster initiatives and policy measures.

- (i) Geographical concentration—has been central to the cluster idea from the outset. Firms may experience that their belonging to a set of inter-related actors which—in a given region—can

serve to enhance efficiency, underpins productivity growth and raises innovativeness, especially due to better access to knowledge, ideas and skills.

- (ii) Specialisation—a cluster is traditionally viewed as specialised in the sense that the participating actors are linked together via a core activity, which provides direction towards emphasis on the same markets or processes.
- (iii) The cluster actors—firms form the natural and obvious components or building blocks of clusters. However, clustering is also about pluralism, not about single firms. In the absence of such pluralism, an observed agglomeration is likely to consist of an enlarged enterprise, where the other companies or units may merely serve as sub-contractors or clients in regard to the main entity.
- (iv) Cluster dynamics and linkages: competition and cooperation - the fourth cluster element relates to the connections and interrelations between the actors. Typically, as firms and individuals compete with each other, pressures for improvement are generated. Depending on market characteristics, actors may strive to gain advantage by reducing costs or prices, raising quality, acquiring new customers, or entering new markets. At the same time, the actors in a cluster may cooperate around a core activity, using their key competencies to complement each other. By operating in tandem, firms may also be able to attract resources and services that would not have been available to them isolated.
- (v) Critical mass—in order for a cluster to achieve inner dynamics, it needs to engage numerous actors and reach some sort of critical mass. Critical mass may serve as a “buffer” and make a cluster resistant to exogenous shocks or other kinds of pressures, including “losses” of companies, even when they might be regarded as “key companies”, as long as a critical threshold of remaining players is not exceeded.
- (vi) The cluster lifecycle—clusters and cluster initiatives do not represent temporary solutions to acute problems. They have a sense of direction and inner stability over time. Any cluster will pass through a number of stages. These may not be identical, and the pace of their evolution may vary. Still, there is an inherent logic to the way that clusters develop, which makes it possible to discern certain characteristic patterns.
- (vii) Innovation—here understood in a broad sense, incorporating technical, commercial and/or organisational change.

5.1. Basque Country (Spain)

5.1.1. General Description

In the early nineties of the past century, the Basque Country was in the process of economic decline. Until then, the main competitive advantage of its industry relied on low prices, a strategy that began to fail. The political response from the autonomic government to address these serious structural problems was to adopt the Porterian model of clusters that focuses on inter-industry linkages, as a way to encourage the development of new sustainable and specialized advantages. The primary objective of the Basque cluster policy is to improve the competitiveness of enterprises and of the region through cooperation on strategic projects related to three main areas: technology, quality management and internationalization. This desideratum was operationalized by the Department of Industry, Trade and

Tourism of the Basque Government, through the establishment of associations of clusters (e.g., aerospace, mobility and logistics, audiovisual, paper industry, manufacturing of machine tools, environment, energy, electronics and information, automobile). These associations have as main task to promote the competitiveness of each of the respective clusters, by facilitating and supporting cooperation/collaboration among its members (firms, R & D centres, universities, government institutions, among others). In the field of sea economy, there are two clusters associations: the Uniport Bilbao (ports) and the Foro Maritimo Vasco (shipbuilding).

The whole Basque maritime sector has an important presence in the economy of this Spanish autonomous community, representing approximately 2.5% of its GDP. The companies that comprise invoiced in the year 2008, 1470 million euros in activities directly related to the sector and € 2535 million as a whole. The Basque maritime sector closed the year 2008 with 17,900 associated jobs, of which 9300 are direct jobs. The maritime cluster of the Basque Country comprises two anchor areas: ports and shipbuilding.

The main shipping facility located in the Basque Country is the Port of Bilbao in Biscay, which represents a direct communication gateway between Spain and the rest of Europe. It is a modern and flexible infrastructure, able to receive any type of ship and cargo. The movement of containers in 2007 exceeded half a million TEUs, which puts it in 4th place of the busiest ports in Spain, after Algeciras, Barcelona and Valencia.

The Foro Maritimo Vasco (FMV) is a non-profit organization created in 1993, and since 1999 is recognized as a priority cluster by the Basque Government. The FMV's mission is to represent, defend, consolidate, enhance and improve the competitiveness of Basque companies from the maritime industry through the services it provides, in its different strategic axes (Internationalization, Technology, Excellence in Management, Finance, Audit, Training and Resources Human and Communication, Information and Representation). This association, which also worked actively in the creation of the Spanish Maritime Cluster, is seen in Spain as a pioneering organization in adopting the cluster approach, integrating approximately 30 entities, among companies, associations and public institutions, which includes government departments and universities. The current strategic challenges embraced by the FMV, while cluster association representative of the shipbuilding sector which has been strongly affected by the economic downturn originated from 2008 and suffering from a severe competition promoted by shipyards from Korea and South China, due to their extremely low prices, includes the promotion among its members of a culture for continuous innovation effort in products and organizational, business and marketing processes. Table 1 presents a synthesis for the current position of the maritime cluster of the Basque Country in relation to the seven cluster key dimensions adopted for the benchmarking analysis carried out in this article [15].

Table 1. The position of the maritime cluster of the Basque Country in relation to the adopted seven key elements.

Maritime clusters benchmarks		
Cluster key dimensions (according to Andersson <i>et al.</i> [15]):	I) Basque Country (Spain)	Evaluation
(i) Geographical concentration: firms locate in geographic proximity due to hard factors, such as external economies of scale, as well as soft factors such as social capital and learning processes;	Bilbao is one of the seven major seaports in Spain. The Port is capable of generating a high beneficial effect on the regional economy. Apart from the port industry by definition, the Port of Bilbao, is a driver for the development of other auxiliary sectors.	+
(ii) Specialisation: clusters are centred around a core activity to which all actors are related;	The maritime cluster of the Basque Country comprises two anchor areas: ports and shipbuilding. The Port of Bilbao is included within the service sector linked to the internationalization of industrial companies, both in his role as an importer and exporter.	+
(iii) Multiple actors: clusters and cluster initiatives do not only consist of firms, but also involve public authorities, academia, members of the financial sector, and institutions for collaboration;	At present, the Basque Maritime Forum (BMF) is made up of an heterogeneous group of members, representing different sectors, such as: <ul style="list-style-type: none"> • Institutions • Technology Centres • Associations in the Maritime Sector • Financial entities • Basque State University. • Companies. • Chambers of Commerce. • Port Authorities. • Museums. 	+
(iv) Competition and co-operation: this combination characterises the relations between these interlinked actors;	BMF organises workshops and work groups to foster cooperation and knowledge sharing among marine industry actors and they provide them with tools to tackle issues that wouldn't be possible to deal with in an individual basis. One of the main future objectives are the creation of the network of cooperative research centres (CIC) and centres of excellence research (BERC), along with Ikerbasque program of attraction of research talent.	0
(v) Critical mass: is required to achieve inner dynamics;	The companies of the Basque maritime sector have charged in the year 2008, by means of activities directly related to the maritime sector, 1 500 million Euros and have achieved the employment of 9 100 employees. The Basque maritime companies are classed into these lines of activity: shipbuilding, fishing and merchant vessel operators and auxiliary industry (equipment manufacturers and subcontractors), accounting for approximately 2.1% of the Basque GDP. The main products exported by the Basque maritime sector, some of whom are first-order global benchmarks, are FORAN Software design, equipment such as motors, pumps, tuna vessels, suction dredgers, offshore vessels, etc. The multimodal connections linking the Port of Bilbao with the main Spanish and European road and railway networks favour smooth and fast direct freight movements with a hinterland in continuous economic growth.	–

Table 1. Cont.

Maritime clusters benchmarks		
Cluster key dimensions (according to Andersson <i>et al.</i> [15]):	I) Basque Country (Spain)	Evaluation
(vi) The cluster life cycle: clusters and cluster initiatives are not temporary short-term phenomena, but are ongoing with long-term perspectives, and finally;	<p>The maritime cluster association is integrated within the cluster program of the Basque Government (since 1997). Industrial reconversion of the large shipyards in the 1980s (heavy cuts on capacity and employment, with key financial support of the Spanish government) and of the small & medium shipyards in the 1990s (small support of the Basque Government). The current situation is becoming worse and new challenges are arising when it comes to the future of shipbuilding. For the case of the Basque Country cluster, this extends beyond the problems created by the recession in terms of a lack of job growth and lack of funding and is directly related to competitiveness. The global crisis that started in 2008 has accentuated the economic recession that the shipbuilding sector was suffering due to the introduction in the offer of countries like South Korea and China with an increasing strength and a rapid demand of the ships. Notable for their low prices, they have destabilized the market in their favour.</p> <p>Generally speaking, taking an in-depth approach to the industry as a whole, one can notice that when it comes to knowledge management or innovation, there is an important gap to be covered and it is a real challenge to address this kind of issues in such traditional sector.</p>	–
(vii) Innovation: firms in clusters are involved in processes of technological, commercial and/or organisational change.	<p>The Basque government cluster program put forward policies to support research. These included the creation of generic technological centres that carry out research in several areas and, specifically, the establishment of Azti-Tecnalia, a technological centre specialized in marine technologies. Specialized education has also been supported both by the regional government and the EU. The Basque government also subsidizes private R&D projects.</p>	0

Legend: (+) strong; (0) neutral; (–) weak.

5.2. Lander of Schleswig-Holstein (Germany)

5.2.1. General Description

Schleswig-Holstein, covering a total area of 15,763 km², is the most northern and most “maritime” of Germany’s “Länder”. It is located just south of Denmark’s Jutland peninsula between two seas: the North Sea, on the west coast, and, on the east coast, the Baltic Sea. The total coastline along both seas is 1190 km.

Schleswig-Holstein is a composite maritime cluster, comprehending several networks within it, differing in intensity. Various maritime activities are well established in Schleswig-Holstein. Some are associated with the metropolitan region of Hamburg which represents both a major maritime cluster given Hamburg’s status as one of the most important ports in Europe and the third largest for container traffic after Antwerp and Rotterdam and also a significant maritime financial centre offering many insurance services.

The cluster components include: port industry, maritime logistic, shipping companies, shipbuilding and engineering services, marine equipment suppliers, maritime services, offshore technology (specially offshore wind), oceanography and university marine science laboratories, marine and coast protection, blue (marine) biotechnology, fishing, aquaculture, maritime tourism (aquatic sports, cruises). Shipping, marine equipment, shipbuilding and marine tourism together accounted for a turnover of €7.5 billion in 2006, representing the most important components of the Schleswig-Holstein maritime sector.

This cluster has two important characteristics: a high intensity of RDI by firms, especially by those belonging to the suppliers of equipment and components for shipbuilding sectors, especially in the areas of energy efficiency, environment, maritime safety and offshore energy, participation in international networks and relationships with clusters from other countries (Baltic Sea, United Kingdom, Denmark, Norway, Holland, France and Poland). There are several cooperation networks operating in the Schleswig-Holstein area (“Maritime Cluster Schleswig-Holstein”, “German Hydrographic Consultancy Pool”, “German Gashydrate Organization”, “Marina Networks”) and since July 2008 was formally constituted a management entity for the *maritime cluster*, which includes as partners, besides the Lander government, the Trade and Industry Chamber of the Lander e o Business Development and Technology Transfer Corporation of Schleswig-Holstein (WTSH), among others. The observations made above and their correlation with the seven cluster key dimensions are summarised in Table 2.

Table 2. The position of the maritime cluster of Schleswig-Holstein in relation to the adopted seven key elements.

Maritime clusters benchmarks		
Cluster key dimensions (according to Andersson <i>et al.</i> [15]):	II) Lander of Schleswig-Holstein (Germany)	Evaluation
(i) <i>Geographical concentration</i>	Various maritime activities are well established in Schleswig-Holstein. Some are associated with the metropolitan region of Hamburg which represents both a major maritime cluster given Hamburg’s status as a very important port in Europe and also a significant maritime financial centre offering many insurance services. The urban area is a focus too for ship-repair and ship engineering industries, marine equipment suppliers, hydrographic services (BSH) and university marine science laboratories.	+
(ii) <i>Specialisation</i>	Major activities centre on merchant and naval ship industries, marine equipment, shipping and seaports as well as various other sectors such as coastal engineering, marine tourism, fishing and aquaculture and marine sciences.	+

Table 2. Cont.

Maritime clusters benchmarks		
Cluster key dimensions (according to Andersson <i>et al.</i> [15]):	II) Lander of Schleswig-Holstein (Germany)	Evaluation
(iii) Multiple actors	With an annual turnover of €8.5 bn, nearly 1700 businesses employing some 47,000 people and at least 15 educational and research establishments, the maritime economy in Schleswig-Holstein is a significant economic factor with outstanding growth potential. Since July 2008 was formally constituted a management entity for the maritime cluster, which includes as partners, besides the Lander government, the Trade and Industry Chamber of the Lander and the Business Development and Technology Transfer Corporation of Schleswig-Holstein (WTSH), among others.	+
(iv) <i>Competition and co-operation</i>	There are several cooperation networks operating in the Schleswig-Holstein area (“Maritime Cluster Schleswig-Holstein”, “German Hydrographic Consultancy Pool”, “German Gashydrate Organization”, “Marina Networks”).	0
(v) <i>Critical mass</i>	Schleswig-Holstein is the base for around 1700 companies in the maritime industry with an annual turnover in 2006 of € 8.5 billion and employing upwards of 47,000 people. Schleswig-Holstein is the base of outstanding scientific maritime institutions, including Christian-Albrechts-Universität (CAU), the Helmholtz-Centre GEOMAR, the Helmholtz-Centre Geesthacht, two divisions of the Bremerhaven Aldred-Wegener-Institute for Polar and Maritime Science, and the Fraunhofer-Institute for Marine Biotechnology.	+
(vi) <i>The cluster life cycle</i>	The three states of Hamburg, Lower Saxony and Schleswig-Holstein launched a mutual cluster management venture entitled Maritime Cluster Northern Germany. Their aim is to strengthen the competitiveness of the maritime industry within the landers even more effectively than before by consolidating existing networks and cooperation beyond state borders, as well as through regional projects. The Maritime Cluster Northern Germany is present throughout the region, with offices in Kiel, Hamburg and Elsfleth.	+
(vii) <i>Innovation</i>	Training and research within the cluster employ about 1000 people. There’s a high intensity of RDI by firms, especially by those belonging to the suppliers of equipment and components for shipbuilding sectors, especially in the areas of energy efficiency, environment, maritime safety and offshore energy. Intensive cooperation with research facilities in innovation fields: energy efficiency, environmental balance, security (shipping), commodities and alternative maritime energies. Over the past years, Schleswig-Holstein has supported projects which were concerned with technological developments, for instance in the field of aquaculture through GMA (National centre for aquaculture) and Submariner (Sustainable Uses of Baltic Marine Resources). The significance of marine research in Schleswig-Holstein is strengthened by the excellence cluster “Future Ocean”.	+

Legend: (+) strong; (0) neutral; (–) weak.

5.3. The Netherlands

5.3.1. General Description

The Dutch history is inseparable from the sea. Small country with 300 km long and 200 km wide, is strategically located in the heart of Europe, with which communicates via two major arteries: the Black Sea and the Rhine, elements that largely shape the cultural and maritime past of the Netherlands. The first area of specialization of its economy occurred in the activities of fisheries, ports, shipping, trade and maritime works. Some of its cities participated in the formation of the Hanseatic League (or Hansa), a kind of market economic alliance that developed in the Baltic Sea area. The strength of this set of maritime activities has enabled the Netherlands to become the most powerful maritime European nation then. In 1602, with the merger of several companies who were engaged in international maritime trade, was born what was to become the first multinational company with shares listed on the stock exchange market: the Dutch East India Company.

The vocation and importance of activities related to the sea economy in the Netherlands remained until the present day. According to data from Policy Research for 2001, the aggregate of the Dutch maritime sectors represented up to 10% of the value added generated by all the maritime industries in the EU, and their share in the Dutch GDP is twice the European average. In 2002, the Dutch maritime cluster has generated 190,000 jobs, 135,000 of which were direct jobs and represented 5.4% of the Dutch national exports. The high export quote of more than 60% illustrates the international competitiveness and international orientation.

The Dutch Maritime Network is an independent foundation established to strengthen and promote the Dutch Maritime Cluster, and to increase the cohesion and visibility of its eleven maritime sectors constituents (Logistics/Freight Shipping, Shipbuilding, Marine Equipment Suppliers, Offshore Resource Exploration, River Transport, Dredging, Ports, Marine Services, Fisheries, Navy, Royal Dutch War and Yacht Construction Industry). The companies in the maritime cluster are grouped in trade organizations, which are funded by member contributions and who perform business activities on behalf of their members. Its main function is to lobby for its members at various levels of government: local, regional, national and European level, either directly or as members of European and global associations. The Dutch Maritime Network was formed to act as a platform for contact and networking of these trade organizations (which are part of it), working actively with them to improve the image of the maritime policy and maritime cluster in the Netherlands, developing an intense activity in areas of communication, business internationalization, innovation and job market/education in the maritime sectors. The administration of the Dutch Maritime Network is composed of prominent personalities from various marine and industrial sectors in the Netherlands. The central government has an observer on this board, but no formal power for direct intervention in the management of the funds available to the foundation. In Table 3 an evaluation is made for the current position of the Dutch maritime cluster in relation to the seven cluster key dimensions proposed.

Table 3. The position of the Dutch maritime cluster in relation to the adopted seven key elements.

Maritime clusters benchmarks		
Cluster key dimensions (according to Andersson <i>et al.</i> [15]):	III) The Netherlands	Evaluation
(i) Geographical concentration	<p>Since many maritime activities are quite 'footloose' they cluster together in specific regions in The Netherlands. Firms in such 'cliques' are more tightly related, and the cliques include relations with other activities. Geographical concentration is analysed, since this is a key indicator of the existence of 'cliques'. An analysis of the concentration of maritime activities in certain regions, three 'cliques' are identified, two in the port regions of Rotterdam and Amsterdam and a 'shipbuilding clique' in the Northern Netherlands.</p>	0
(ii) <i>Specialisation</i>	<p>The Port of Rotterdam is Europe's largest port by far and Amsterdam is Europe's fourth-largest. The core of the 'maritime cluster' is that all activities have to do with the building or operation of ships. Activities strongly related to building and operating ships, such as port services, maritime services and ship suppliers are included in the cluster.</p>	+
(iii) Multiple actors	<p>The Dutch maritime business communities are organized in trade organizations, who in turn participate in the Dutch Maritime Network. The Dutch knowledge institutes like Marin, the research institute TNO, the Technical University of Delft and the Royal Institute for the Navy participate in the Maritime Knowledge Centre (in Dutch: Maritiem Kennis Centrum). For easy communication and joint action both cluster organizations have cross participations and share some board members and observers. Additionally both the Ministry of Transport and of Economic Affairs are represented by observers.</p>	+
(iv) <i>Competition and co-operation</i>	<p>The Dutch maritime cluster comprises 11 different, yet complementary industries that operate within a 100-kilometre radius. This encourages close co-operation on innovation and production, allowing industries to build on each other's strengths. The government, academia and the private sector are implementing a long-term innovation programme that focuses on the need of the energy sector to embrace LNG, the production of gas and oil in ultra-deep water, and the ongoing growth of global shipping.</p>	+
(v) <i>Critical mass</i>	<p>The Dutch maritime cluster comprises 11 sectors and 11,850 companies, and as such, is arguably one of the most complete maritime clusters in the world. The 11 maritime sectors are shipping, shipbuilding, marine equipment, offshore, inland navigation, dredging, ports, maritime services, fishing, yachting, and the Dutch Royal Navy.</p>	+

Table 3. Cont.

Maritime clusters benchmarks		
Cluster key dimensions (according to Andersson <i>et al.</i> [15]):	III) The Netherlands	Evaluation
(vi) <i>The cluster life cycle</i>	<p>After the rapid expansion in the 1970s, the contraction and restructuring in the Netherlands was painful but fast. Consequently, a new industry model emerged for the shipyards. The yard became the assembly plant where many subcontractors contributed to the construction. A flexible and low cost shipbuilding and marine equipment sector was the end result which specialises in relatively small ships.</p> <p>The national flag fleet of the Netherlands declined gradually after the second oil crisis, and this lasted until the new shipping policy was introduced by 1996. Since then the fleet has grown with more than 60 percent.</p>	+
(vii) <i>Innovation</i>	<p>Innovation is a prime responsibility of the entrepreneurs, but the government has created, as in any industrialised nation, a number of generic instruments to stimulate innovative behaviour and the innovative capacity of people and companies. A Maritime Innovation Forum was created to strengthen the innovation networks between the sectors and the maritime cluster as a whole. In this Forum the participating trade organisations co-operate and initiate cross-sector innovation projects.</p> <p>The cluster, in cooperation with businesses, has created an innovation vision (Maritime Innovation Program) for the maritime building industry and offshore services. The program consists of projects in R&D, SME activities, human capital and knowledge activities.</p>	+

Legend: (+) strong; (0) neutral; (-) weak.

5.4. Norway

5.4.1. General Description

The maritime tradition in Norway is ancestral. Archaeologists have found traces of vessels dating from the Paleolithic and there is evidence of the practice of maritime trade since the early Bronze Age. The Vikings were skilled navigators and builders of fast warships, which reached the remote corners of the planet. Along the first centuries of the first millennium, trade and naval transport grew rapidly, with the Hanseatic city of Bergen playing a central role in that process. During the industrial revolution in the nineteenth century, the Norwegian shipbuilding industry would assume a global scale. In the post-oil crisis of 1973, the Norwegian merchant fleet went through a process of profound transition. To respond to growing global competition and pressure to reduce their operating costs, many ship owners abandoned the Norwegian flag and the crews of their ships were replaced by seamen from those foreign countries earning lower wages. The turnaround began in 1987 with the introduction of the Norwegian International Ship Register (NIS) which allowed the ship owners to employ foreign seamen with wages equivalent to those practised on their countries of origin, associated with the change in taxation for companies and seafarers.

Norway has 10% of the world merchant fleet, placing it in the top three world ranking, and carries out 15% of the global oil exploration activities in the nearshore. The sea-related activities in Norway are the third largest industry in the country, surpassed only by the financial sector and the offshore oil and natural gas (that Norway is Europe's largest producer).

The main components of the Norwegian cluster are: Maritime Shipping, Marine Equipment Suppliers (mainly for the offshore oil and natural gas); Maritime Services (finance, insurance, brokering, maritime law, classification and certification of ships, port services); Shipbuilding (specialized vessels for oil prospecting and exploration, highly sophisticated cruise ships, factory ships and fishing vessels, including equipment for propulsion and navigation, patrol boats, specialized vessels for the transportation of chemicals and liquefied natural gas, icebreaker vessels), and Fisheries. All these sectors, especially those related to shipbuilding and equipment/marine machinery, are characterized by a strong RDI intensity, involving companies, universities and public RDI centres.

There is an organization that serves as a network platform, linking the various sectors and their respective actors at various levels (the Maritime Forum), founded in 1990, which aims to strengthen cooperation mechanisms within the cluster, as well as to influence policies for the marine industry and defend their interests in international affairs. The evaluation made in terms of the position of the Norwegian maritime cluster in relation to the adopted seven key elements is displayed in Table 4.

Table 4. The position of the Norwegian maritime cluster in relation to the adopted seven key elements.

Maritime clusters benchmarks		
Cluster key dimensions (according to Andersson <i>et al.</i> , 2004):	IV) Norway	Evaluation
(i) Geographical concentration	The maritime cluster in Norway is not based in one region of the country. It is concentrated in different regions along the coastline. The maritime industry is concentrated in: <ul style="list-style-type: none"> • The Oslo area; • Vestfold, Buskerud and Telemark counties; • Aust- and Vest-Agder counties; • Rogaland county; • Hordaland and Sogn og Fjordane counties; • Møre og Romsdal county; • The middle region of Norway. 	0
(ii) Specialisation	The shipping companies are the most central actors in the maritime industry. They are strongly related to most of the industries within the sector. Also, the classification services, shipping consultants, and shipbuilding have many strong and medium strong links to the rest of the maritime sector.	+
(iii) Multiple actors	The maritime industry in Norway constitutes a complete cluster, composed of three main groups; shipping, maritime services and ship industry. These three main groups surrounded by facilitating associations, educational & research institutions and political bodies.	+

Table 4. Cont.

Maritime clusters benchmarks		
Cluster key dimensions (according to Andersson <i>et al.</i> [15]):	IV) Norway	Evaluation
(iv) <i>Competition and co-operation</i>	<p>Half of the Norwegian companies cooperate with other firms around R&D and the supplier-buyer cooperation to improve innovation is particularly strong. This, combined with the fact that Norwegian firms to a larger extent participate in external R&D projects and to a lesser extent conduct R&D in-house, indicates again that the primary strength of the maritime industry is not in the single companies but in the cluster as a whole.</p> <p>The relationships between the industries in the same sector are strong and there are strong relationships between what is traditionally labelled as shipping (shipping companies, ship brokerage services, insurance, bank/finance, classification, consultants, other services) and the shipping supply industry (ship building, equipment, engines, wholesale).</p>	+
(v) <i>Critical mass</i>	<p>In 2007, the activities of the maritime cluster originated revenues of €12 billion (11% of the value generated in the economy), employing 97,000 people (29% in shipping, 26% in equipment suppliers and marine machinery, 24% in marine services and 21% in shipbuilding and repair). Consisting of ship designers, ship builders, ship operators, service and equipment suppliers, significant R&D activities and education within the marine and maritime field, the Norwegian maritime cluster represents the entire maritime value chain, from ship design to shipping, as well as all relevant ancillary industries. Thus, it can be argued that the Norwegian maritime cluster is one of the most complete maritime clusters in the world.</p>	+
(vi) <i>The cluster life cycle</i>	<p>Overall, the historical performance has been very good, but the industry is showing signs of weakness. The shipping industry is the engine and the core of the industry, and its unclear fate creates an uncertainty for the future of the rest of the industry.</p> <p>Also the Norwegian oil and gas industry may be facing a similar situation. For three decades the Norwegian continental shelf has been an attractive location due to large and profitable oil fields. The recent decline in investments indicates that the Norwegian sector may be losing its attractiveness. As a result of the decreasing home market, the Norwegian offshore industry has been under heavy pressure recently. This reveals that many Norwegian offshore suppliers, although they are technologically advanced, lack international competitiveness. If these companies' competitiveness is not enhanced substantially, Norwegian oil and gas may become a sunset industry.</p>	–
(vii) <i>Innovation</i>	<p>The Norwegian maritime industry is the source of many important innovations in for example ship design, navigation, and advanced equipment. Norway seems also to be quite attractive as a location of R&D. Thus, it seems reasonable to expect maritime companies in Norway to be quite R&D intensive. However, compared with Dutch, German, Danish and British firms, Norwegians are the least R&D intensive. The innovation level is, however, quite high. This seems to imply that Norwegian companies get higher returns from their R&D investments than companies in the other countries do.</p>	+

Legend: (+) strong; (0) neutral; (–) weak.

Subsequently to the observations made so far, we can notice that the evolution of maritime clusters emanates from both deterministic (legacy, culture, history, availability of specific natural resources) and proactive forces (e.g., Lowering transaction costs especially in accessing and transferring knowledge; Economies of scale and scope; Specialisation of supply from factor markets with respect to labour, capital, or technology sources; Accessing and sharing information on market and technology change; Triggering learning processes and more sophisticated demand; Strengthening the leverage of public/private cooperation through centres of maritime excellence). Clusters are not *ex nihilo* creations, very often they are based on skills existing locally since long ago. Most of the cluster initiatives described above represent organised efforts to enhance the competitiveness of a certain cluster within a particular region, involving private business, public bodies and/or academic institutions. To accomplish this, a satisfactory coupling between government, capital and knowledge is needed for entrepreneurial ventures to succeed in an international maritime market increasingly competitive. These initiatives can be based on a “bottom-up”/“top-down” or “hybrid” (by combining the latter) approach, and very often they are managed by specialised institutions, such as cluster associations, which have tight connections with RDI entities. Among their various achievements, knowledge dissemination (although varying in intensity from case to case) is common to all clusters, once the development of maritime clusters critically depends on interconnecting firms and RDI bodies through shared knowledge. Also, crosswise to all four European maritime clusters described above there is: a conscious efforts to improve the microeconomic business environment and towards the upgrading of human resources; the expansion of the cluster by stimulating new entrepreneurship and attracting outside firms to the cluster; commercial collaboration such as joint export initiatives or coordinated purchasing to increase purchasing power and generate scale economies; and the permanent upgrading of technology and the establishment of close ties with other international maritime clusters.

The observations made above are consistent with the results (drivers/constraints) out coming from the report on results of the study “The role of Maritime Clusters to enhance the strength and development in maritime sectors” [1], where maritime sectors are divided into clusters (or Areas) in order to focus on developing a European cross-cutting policy approach for the sea-related sectors (combining offshore and coastal activities):

- Area 1: Traditional maritime sectors;
- Area 2: Coastal (and marine) tourism and recreation;
- Area 3: Fisheries.

The main cross-sector trends which have been analysed in this study based upon literature and field research are the following:

- Increase in Research, Development and Innovation (RDI-activities);
- Difficulties with regard to recruitment;
- Limited public awareness of the importance of maritime sectors;
- Sustainable development.

First maritime trend: there is an increase of innovation, research and development activities, especially in marine equipment manufacturing and shipbuilding. European maritime (and non-maritime) manufacturing sectors face tough challenges in competing with low-cost and subsidising countries, mainly in Asia. European Intellectual Property Rights (IPR) have a limited effect on the production

volumes in these third countries of copied European-designed equipment. To maintain their competitive advantage European companies specialise in know-how and expertise and focus on niches through RDI.

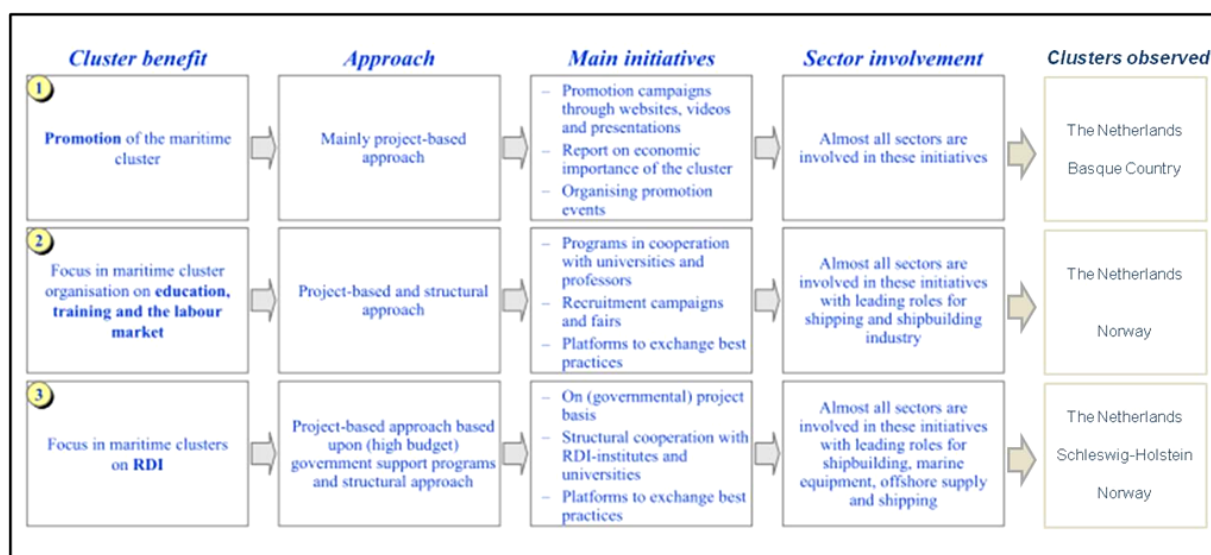
Second maritime trend: problems regarding recruitment. It is difficult to attract potential employees and young people to the maritime sectors (particularly to the offshore professions). Moreover, attracting people to offshore activities is not only important for the shipping and offshore sectors, but also for the onshore maritime sectors when in a later stage of their career offshore staff are of great use because of their valuable experiences and competences (e.g., port and service related). Maritime clusters have a large labour mobility within their sectors.

Third maritime trend: the limited public awareness of the importance of maritime sectors. Because ports and their related manufacturing and services, and consequently ships, have for practical and safety reasons been moving away from cities, the public awareness of the importance of maritime transport seems to have been fading. Maritime sector and cluster organisations often indicate that this limited public awareness of the importance of their activities leads (or could lead) to the aforementioned recruitment difficulties and a shortage of government initiatives and policy.

Fourth maritime trend: because of increasing know-how and awareness of negative external effects on the environment and because of increasing fuel prices in combination with further measures to reduce operational costs, investments and initiatives are made in order to (further) sustainably develop the maritime sectors.

Figure 5 below combines the different approaches in terms of good practices based upon the main cross-sector trends listed above with the findings arising from the benchmarking analysis done previously for the four European maritime clusters selected for this paper.

Figure 5. Good practices of European maritime cluster organisations based upon main cross-sector trends.



Source: Authors, based on Policy Research Corporation [1].

6. Discussion and Conclusions

The birth of maritime clusters may often be traced to specific location factors and historical circumstances and upon the country’s culture. Some of the maritime industries and connected activities

have been part of the global economy since long ago. Although they had to face ups and downs, the arrival of new and low cost competitors from time to time, they have shown strong resilience in sustaining their competitive position, due, in a large extent, to technological innovation and to a continuous capacity for reinventing themselves.

The cluster concept has been successfully applied in various regions, countries and sectors linked to the sea, and some aspects can be assumed as crosscutting to these types of clusters. Although many clusters are concentrated in coastal areas, very often, maritime economy has impacts beyond those coastal regions and because of so it is also necessary to establish relationships with stakeholders from such remote areas. Many times, the challenges faced go widely beyond the simple sharing and collaboration *inter pares* within a specific sector. Very often, the main issues at the basis of the establishment of a maritime cluster organisation are to increase competitiveness, to promote maritime sectors, and to improve coordination within the cluster.

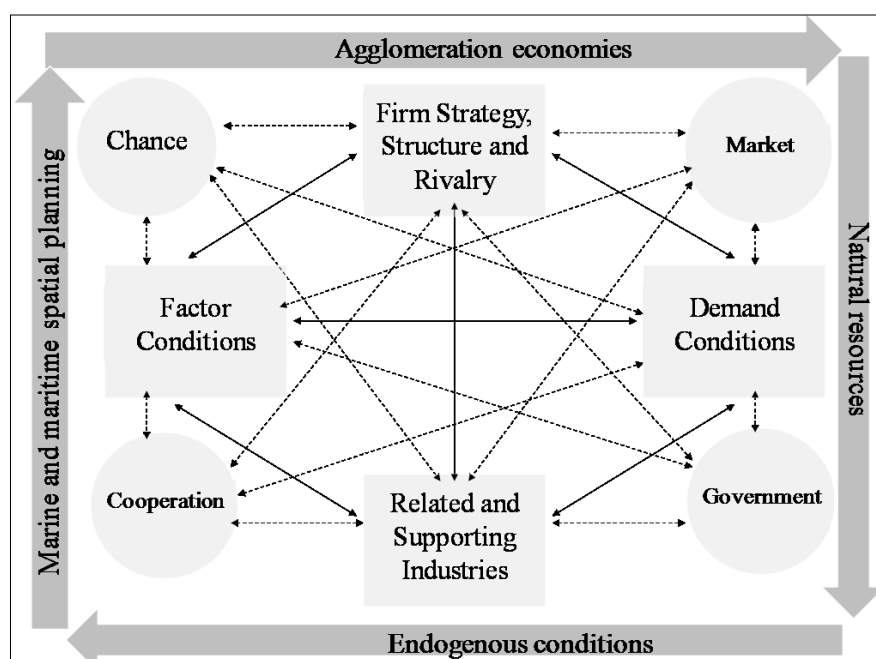
Also important is the relevance frequently assumed in these types of clusters concerning the exploitation (extraction) of natural resources (normally used as raw materials or inputs to production systems) over time and the need for its optimization, both in environmental and economical terms, and the marine and maritime spatial planning, in order to regulate potential conflicts between different uses and users and preserve environmental conditions. Finally, there are certain key factors with high accuracy to the topic at hand: Agglomeration economies that attract firms and resources into a particular geographical area, namely a joint labour pool, a broad supplier and customer base, knowledge spillovers and low transaction costs; Endogenous factors that are inherent to a particular cluster, including not only deterministic conditions such as legacy, culture and history, but also those who have a positive impact on innovation, like the presence of multiple actors deeply interconnected (e.g., firms, business associations, public authorities, universities and RDI centres, financial services, *etc.*), a solid education and training infrastructure, the collective production, management and transfer of knowledge and the carry out of joint RDI activities.

Through the present article, we highlighted those aspects considered of most relevance towards the establishment of a distinctive set of critical factors and key dimensions, understood as essential to attend the singularities and emphasize the idiosyncratic nature of maritime clusters; therefore, whose manifestation is considered crucial to their creation and sustainable development.

Is thus clear if some differentiation exists between “terrestrial” and maritime clusters, that it is related to the absolute critical role that innovation and knowledge networking hold in the latter. The increasingly demanding international contexts where maritime clusters evolve and the permanent source of use conflicts for space allocation and resource depletion, induce a competitive pressure to innovate, because maritime firms are highly dependent upon the introduction of new products, new production processes and new organizational practices, as a way to sustain competitive advantage. Therefore, the consolidation of a critical mass of private and public actors, the existence of adequate conditions for the emergence and sustenance of labour market pooling, based on an appropriate system of education and training, the presence of solid interdependence relations between these multiple and sophisticated actors, are decisive for the genesis and success of those inner dynamics.

From the findings presented so far, a reconceptualised model for the case of maritime clusters, inspired by the Porter Diamond, is shown in Figure 6.

Figure 6. An Adaptation of Porter's Diamond Model: the case of Maritime Clusters.



Source: Authors, based on Porter [17].

Within this framework, the geographic concentration of activities, the intersectoral and intrasectoral linkages and the assembling of local innovation networks, based upon strong cooperation ties between public and private actors, function as strong cluster enablers, allowing maritime firms to benefit from the technological externalities of agglomeration (v.g. better access to strategic information via knowledge sharing, risk sharing, lower transaction costs, scale economies, *etc.*) and proximity effects (pre-emptive access to knowledge, specialised technical, legal and organizational skills, human and financial resources and strategic technologies; knowledge spillovers and localized collective learning effects; physical infrastructures, access to new markets, *etc.*). Due to the increasingly demanding international contexts where European maritime clusters evolve and their high exposure to tradable sectors, we also emphasise the important role played by the market (access, strategic positioning, *etc.*).

Based upon the observations made of the four European maritime clusters chosen in this study and their relation with the different dimensions presented in Figure 6, we were able to establish for the case of European maritime clusters the following differentiation framework.

6.1. Factor Conditions

- Important role often played by historical circumstances, cultural factors and/or the abundance of natural resources (Basque Country, the Netherlands, Norway and Schleswig-Holstein);
- A high quality and multidisciplinary maritime educational infrastructure (the Netherlands, Norway and Schleswig-Holstein);
- Advanced research and development and knowledge transfer infrastructure and policies that stimulate entrepreneurs to innovate, exchange information and take risks together (the Netherlands, Norway and Schleswig-Holstein);
- Sophisticated local labour market with sufficient career prospects (the Netherlands, Norway and Schleswig-Holstein).

6.2. Demand Conditions

- Strong intersectoral exchanges: innovation-dependent highly specialized demand sectors using capital equipment and services produced in other sectors inside the cluster (Norway);
- Presence of strong and internationally oriented demand sectors, such as shipping, nautical tourism and recreational boating, water transport, offshore industries, fishing, Navy and dredging (Basque Country, the Netherlands, Norway and Schleswig-Holstein).

6.3. Firm Strategy, Structure and Rivalry

- Permanent upgrade of products and services, production processes and organizational practices (Basque Country, the Netherlands, Norway and Schleswig-Holstein);
- Presence of leader firms that are able to set demanding standards, trigger innovation and organize a number of companies (from the supply sectors) to address the innovation challenges (the Netherlands, Norway and Schleswig-Holstein);
- High level of intrasectoral relations: locally-based competitors involved in co-opetition processes, which makes it easier for companies to specialise on a narrow part of the value chain due to reduced transaction costs (the Netherlands and Schleswig-Holstein).

6.4. Related and Supporting Industries

- Capable locally-based specialized supply sectors, like naval repair and shipbuilding, marine equipment and maritime services are increasingly exposed to foreign competition (Basque Country, the Netherlands, Norway and Schleswig-Holstein);
- High level of interdependency with the remaining sectors of economic activity (the Netherlands, Norway and Schleswig-Holstein).

6.5. Government

- Focus on the importance of the maritime cluster evolving educational and research institutions, trade and labour associations, financial institutions and other private and government institutions, labour force, entrepreneurs and the general public (Netherlands and Norway);
- Acknowledge the maritime cluster as an important building block of the economy (Basque Country, the Netherlands, Norway and Schleswig-Holstein);
- Create the right conditions for the maritime sector to adapt to a competitive environment that is changing continuously (Basque Country, the Netherlands, Norway and Schleswig-Holstein);
- Existence of an overall industrial policy for the maritime sector (Basque Country, Norway and Schleswig-Holstein);
- Networking/alliances/close contacts with other international maritime clusters (the Netherlands and Schleswig-Holstein).

6.6. Cooperation

- Strengthening the leverage of public/private cooperation through centres of maritime excellence (Basque Country, the Netherlands, Norway and Schleswig-Holstein);

- Accessing and sharing information on technology change (the Netherlands, Schleswig-Holstein and Norway);
- Risk sharing on the development of R&D activities and accessing new markets (the Netherlands, Norway and Schleswig-Holstein);

6.7. Market

- Crucial need for the internationalization of the cluster economic activities (Basque Country, the Netherlands, Norway and Schleswig-Holstein);
- Strong lobby activities on facilitating the access to new markets (Basque Country, the Netherlands, Norway and Schleswig-Holstein);
- Accessing information on new market opportunities and legal access conditions (Basque Country, the Netherlands, Norway and Schleswig-Holstein).

Functioning at the centre of the model above are maritime clusters, understood as integrated ecosystems where innovation-dependent highly specialized producers and capable locally-based specialized suppliers of goods and services, educational and research institutions, financial institutions and other private and government bodies, related through solid forward and backward linkages, evolve in competitive and demanding contexts, which increase the importance of science-based clustering and favours the creation of a “fertile” environment much suitable for the promotion of excellence RDI networks, as well as strong interdependence relations not only with other sectors of economic activity, but also with other international maritime clusters, thereby improving the structural conditions and the competitiveness factors either of the sea related sectors and of the nations/regions involved.

To conclude, with the current paper we presented a set of critical factors and determinants which may embody the proposal of a differentiation framework for the case of European maritime clusters: not all of them must be present at the same time in a particular cluster, but they all are positive structural dimensions towards the creation, resilience and sustainable competitiveness of successful maritime clusters.

Conflicts of Interest

The authors declare no conflicts of interest.

References

1. European Commission. *The Role of Maritime Clusters to Enhance the Strength and Development in EUROPEAN Maritime Sectors—Report on Results, Study Executed by Policy Research Corporation*; European Commission: Brussels, Belgium, 2008.
2. Sørensen, H.; Hansen, L.; Hansen, R. Results from the Work of the European Thematic Network on Wave Energy (WaveNet): Conflicts of interest. Available online: http://www.offshorecenter.dk/log/bibliotek/23WaveNet_Full_Report.pdf (accessed on 30 August 2013).
3. Krautkraemer, J. Economics of Natural Resource Scarcity: The State of the Debate. In *Discussion Paper 05–14 Resources for the Future*; Resources for the Future: Washington, DC, USA, 2005.

4. Portuguese Ministry of Defense. EMAM—Portuguese Task Group for Maritime Affairs. In *National Strategy for the Sea*; Portuguese Ministry of Defense: Lisboa, Portugal, 2007.
5. Sociedade de Avaliação Estratégica e Risco (SaeR). *The Hypercluster of the Maritime Economy: A Domain of Potential Strategic Development for the Portuguese Economy*; Associação Comercial de Lisboa: Lisboa, Portugal, 2009.
6. Cooke, P.; Porter, J.; Cruz, A.; Pinto, H. *Maritime Clusters—Institutions and Innovation Actors in the Atlantic Area*; University of Algarve: Faro, Portugal, 2011.
7. Faíña, J.; López-Rodríguez, J.; Montes-Solla, P. Case Study Basque Country (Es). Available online: http://ec.europa.eu/regional_policy/sources/docgener/evaluation/pdf/expost2006/wp4_cs_basque_country.pdf (accessed on 30 August 2013).
8. Franco, S.; Valdaliso, J.; Elola, A.; López, S. Public policies and cluster life cycles: insights from the basque country experience. Available online: <http://foreigners.textovirtual.com/rip2012-porto/2863/RefCluster18SusanaFranco.pdf?1351178157> (accessed on 30 August 2013).
9. Borel, G.; Michałowska, M.; Tronchin, M.; Vandenbroucke, E.; Rehm, S. InterMareC—Interregional Maritime Cluster: The Benefit of Interregional Cooperation. Available online: <http://www.arp.gda.pl/plik,29,w-jezyku-angielskim.pdf> (accessed on 30 August 2013).
10. CPMR. Europe of the Sea. Final report—1st volume Strategic Evaluation of Maritime Activities. Available online: http://www.crpm.org/pub/docs/87_rapport_final_vol1_09_2006.pdf (accessed on 30 August 2013).
11. Jakobsen, E.; Mortensen, A.; Vikesland, M.; Cappelen, A. Attracting the winners. The competitiveness of five European maritime industries. Available online: http://menon.no/upload/2011/09/28/attracting_the_winners.pdf (accessed on 30 August 2012).
12. Langen, P. Clustering and performance: the case of maritime clustering in The Netherlands. *Marit. Pol. Mgmt.* **2002**, *29*, 209–221.
13. Wijnolst, N.; Jenssen, J.; Sødal, S. *European Maritime Clusters: Global Trends, Theoretical Framework, The Cases of Norway and the Netherlands, Policy Recommendations*. Foundation Dutch Maritime Network: Rotterdam, The Netherlands, 2003.
14. Wijnolst, N., Ed. *Dynamic European Maritime Clusters*. IOS Press: Lansdale, PA, USA, 2006; Volume 30.
15. Andersson, T.; Serger, S.; Sörvik, J.; Hansson, E. *The Cluster Policies Whitebook*; International Organisation for Knowledge Economy and Enterprise Development: Malmö, Sweden, 2004.
16. Salvador, R. Os Clusters Marítimos. *Revista de Marinha* **2010**, *954*, 28–30, (in Galician).
17. Porter, M. *The Competitive Advantage of Nations*; Free Press: New York, NY, USA, 1990.
18. Porter, M. *On Competition*; Harvard Business School Press: Boston, MA, USA, 1998; p. 29.
19. Altenburg, T.; Meyer-Stamer, J. How to promote clusters: Policy experiences from Latin America. *World Dev.* **1999**, *27*, 1693–1713.
20. Carpinetti, L.; Gerolamo, M.; Galdámez, E. Continuous innovation and performance management of SME clusters. *Creat. Innov. Manag.* **2007**, *16*, 376–385.
21. Sornn-Friese, H. Navigating Blue Denmark—The Structural Dynamics and Evolution of The Danish Maritime Cluster. Available online: http://www.soefartsstyrelsen.dk/SiteCollectionDocuments/Publikationer/Skibsfartspolitik%20og%20erhvervs%20vilk%C3%A5r/Navigating_Blue_Denmark.pdf (accessed on 30 August 2013).

22. Malecki, E.; Poehling, R. Extroverts and introverts: Small manufactures and their information sources. *Entrep. Reg. Dev.* **1999**, *11*, 247–268.
23. Karlsson, C. *Handbook of Research on Cluster Theory*; Edward Elgar Publishing Limited: Cheltenham, UK, 2008.
24. Neto, P. *A Integração Espacial, Economias de Rede e Inovação* (in Portuguese); Instituto Piaget: Lisboa, Portugal, 1999.
25. Ketels, C.; Lindqvist, G.; Sölvell, Ö. *Clusters and Cluster Initiatives*; Center for Strategy and Competitiveness, Stockholm School of Economics: Stockholm, Sweden, 2008.
26. Ketels, C. Clusters, Cluster Policy, and Swedish Competitiveness in the Global Economy. In *Expert Report No. 30 to Sweden's Globalisation Council*; The Globalisation Council: Stockholm, Sweden, 2009.
27. Holte, E.; Moen, Ø. Successful Maritime Clusters: Key Drivers and Criteria. In *IGLO-MP 2020 Working Paper 01–2010*; Norwegian University of Science and Technology: Trondheim, Norway, 2010.
28. Menzel, M.-P.; Fornahl, D. Cluster life cycles—dimensions and rationales of cluster evolution. *Ind. Corp. Change* **2010**, *19*, 205–238.
29. Aziz, K.; Richardson, S.; Aziz, N. Cluster lifecycle: A case study of the Glasgow-Edinburgh corridor. *Inter. Proc. Econ. Dev. Res.* **2011**, *6*, 159–163.
30. Hakanson, L. Epistemic communities and cluster dynamics: On the role of knowledge in industrial districts. *Ind. Innov.* **2005**, *12*, 433–463.
31. Jaffe, A.; Trattenberg, M.; Henderson, R. Geographic localization of knowledge spillovers as evidenced by patent citations. *Q. J. Econ.* **1993**, *79*, 577–598.
32. Giménez-Roche, G. Entrepreneurial profit-seeking: Socially situating opportunity exploitation. *Ind. Innov.* **2011**, *18*, 729–745.
33. Hindle, K. How community context affects entrepreneurial process: A diagnostic framework. *Entrep. Reg. Dev.* **2010**, *22*, 599–647.
34. Krugman, P.; Venables, A. Integration and the Competitiveness of the Peripheral Industry. In *Unity with Diversity in the European Economy*; Bliss, C., Macedo, J., Eds.; Cambridge University Press: London, UK, 1990; pp. 55–77.
35. Backhaus, J. *Joseph Alois Schumpeter: Entrepreneurship, Style and Vision*; Kluwer Academic Publishers: Dordrecht, The Netherlands, 2003.
36. Etzkowitz, H. The Triple Helix of University–Industry–Government. Implications for Policy and Evaluation. In *Science Policy Institute Working Paper 2002-11*; Swedish Institute for Studies in Education and Research: Stockholm, Sweden, 2002.
37. Goktepe, D. The triple helix as a model to analyze israeli magnet program and lessons for late-developing countries like Turkey. *Scientrometrics* **2003**, *58*, 219–239.
38. Leydesdorff, L.; Etzkowitz, H. The transformation of university-industry-government relations. *Electron. J. Sociol.* **2001**, *5*, 1–17.
39. Leydesdorff, L.; Etzkowitz, H. Can “the public” be considered as a fourth helix in university-industry-government relations? *Sci. Public Policy* **2003**, *30*, 55–61.
40. Liljemark, T. *Innovation Policy in Canada. Strategy and Realities*; Swedish Institute for Growth Policy Studies: Östersund, Sweden, 2004.

41. DG Enterprise and Industry. Innovation Clusters in Europe: A Statistical Analysis and Overview of Current Policy Support. In *Europe Innova/PRO INNO Europe Paper 5*; Office for Official Publications of the European Communities: Luxembourg, Luxembourg, 2007.
42. Mytelka, L. Local systems of innovation in a globalized world economy. *Ind. Innov.* **2000**, *7*, 15–32.
43. Noronha Vaz, T.; Nijkamp, P. Knowledge and innovation: The strings between global and local dimensions of sustainable growth. *Entrep. Reg. Dev.* **2009**, *21*, 441–455.
44. Noronha Vaz, T.; Cesário, M.; Fernandes, S. Interaction between innovation in small firms and their environments: An exploratory study. *Eur. Plan. Stud.* **2006**, *14*, 95–117.
45. Amin, A.; Cohendet, P. Geographies of knowledge formation in firms. *Ind. Innov.* **2005**, *12*, 465–486.

© 2013 by the authors; licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution license (<http://creativecommons.org/licenses/by/3.0/>).