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THE IDIOSYNCRATIC NATURE OF MARITIME CLUSTERS: CONSIDERATIONS FOR THEIR POSSIBLE DIFFERENTIATION

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Abstract

The main objective of the current paper is to distinguish the most relevant aspects which can or should be observed in maritime clusters and are most likely to contribute to their inherent idiosyncratic nature. Based on a literature survey and on a benchmarking presentation of four successful examples of European maritime clusters, we use a study research methodology to substantiate the proposal of a possible differentiation framework for these types of clusters. Our purpose is to point out some of the main characteristics and critical factors for success that are inherent to maritime clusters. Although rarely addressed among the various authors considered in the literature review, our intention is to find out what distinctive competitiveness factors should be considered in a targeted multi-sectorial cluster approach to the economy of the sea, i.e. those that are likely to influence the creation, sustainable development and resilience of successful maritime clusters.

Keywords: "maritime cluster", "differentiation", "specialization", "critical mass".

JEL classification: O13; O33; Q55; R11; R58

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INTRODUCTION

Despite all the efforts to improve the environmental quality of coasts and seas around the world, degradation of ocean environments has continued. In addition, the lack of an integrated approach when using this shared resource has often caused conflict among economic, environmental and social objectives. The 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 (2005) 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.

Around the world in recent decades, awareness has emerged that the management and governance of the ocean, coastal zones and human activities associated with them should be addressed using an ecosystem approach of sustainable development. Such an approach is based on a comprehensive view that is not sectorial but integrated towards (EMAM, 2007, p.13):

> "[t]*he 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.* "

This configures the core of a long-term strategy to support sustainable growth in the maritime sector as a whole, in what has recently been called "Blue growth" strategy. According to SaeR (2009), the advantages of a cluster approach are almost unanimous among the scientific community. The concept of the Hypercluster of the Sea 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. Because such an approach to the

issues from the sea is systemic, it 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 the sea's resources.

In this context, Porter (1998, p.197) gives us an instrumental definition of the cluster concept, which will serve as the guiding thread for the problem addressed in this article:

> *"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."*

The organisation of economic activities into a cluster is advocated by several authors (Porter, Markusen, and Gordon and McCan) as the territorial configuration most suited to stimulating the processes of learning and knowledge creation. According to Porter (1998b), clusters are a form of spatial organization consisting of geographic concentrations of companies and institutions inter-linked in a particular area, including in its organization a series of industries and other entities linked to each other. They include, for example, suppliers of specialized inputs such as components, machinery and services, as well as providers of specialized infrastructure. Clusters also often extend downstream, to commercialization channels and customers, and laterally, to complementary industries and related activities. Finally, many clusters include governmental and nongovernmental institutions, particularly universities, polytechnics, professional associations of business and trade, which have a decisive role in the overall level of competition observed in the market and that can add value to the industry. Porter states that a cluster is the full manifestation of the functioning of the "diamond" economy, in which proximity (understood as the placement of companies, customers, and suppliers) amplifies all the existing pressures to innovate and improve economic performance. The effects of localized learning mentioned above are central for the existence of industrial clusters with a local basis (Markusen, 1996; Cooke, 2001). This localized learning that companies may benefit from consists essentially of technological spillovers that originate in dominant or innovative companies and spread to the followers (Markusen, 1996; Maskell, 2001). These knowledge spillovers are very important for growth because it is understood that they create increasing returns to scale since, according to the theory of endogenous growth, in most models endogenization of technical progress will be based on the assumption that the increasing stock of knowledge is the real engine for growth.

The aim of the current paper is to analyse and identify the relevant characteristics related to the creation and development of maritime clusters. To

do so, we posed the following research questions: What are the most important specifications inherent to a "maritime cluster"? Is there any difference between a "marine cluster" and a "cluster of economical activities essentially based on land"? Although rarely addressed among the various authors considered in the literature review, our intention is to focus on the critical factors that influence the creation, sustainable development and resilience of successful maritime clusters, and on how their respective competitiveness factors are greatly enhanced by the formation of multi-sectorial clusters, which are instrumental to maintain the know-how related to maritime/marine activities and to leverage public/private cooperation through centres of maritime excellence while concomitantly providing a good framework to contextualize the interactions between the different industries and players involved.

As main results arising from this paper, the reviewed research shows that a cluster environment holds advantages for sea related activities due to with the existence of positive externalities that facilitate the development and sharing of specialized labour pools, knowledge and information. Successful maritime clusters rely heavily upon the triple helix of university-industry-government relations. The synergy of the three helices that compound this model of network innovation is the most efficient way to disseminate and use knowledge and enhance learning. These aspects of a maritime cluster enhance dynamics such as cooperative competition ("co-opetition"), innovation pressures and an overlay of communications and negotiations among the cluster actors that become increasingly important for the dynamics of the overall system.

In order to contextualise and justify the views developed in this paper, a survey methodology will examine the role of four aspects that are critical for maritime clusters: 1) Agglomeration Economies arising from Geographical Proximity, 2) Management of Natural Resources and Marine/Maritime Spatial Planning; 3) Endogenous Conditions; and 4) Production and Transfer of Knowledge and Innovation Networks.

The organization of the paper is as follows: the next section elaborates on the economic importance of sea related activities. Section 2 introduces the data collected through benchmarking. In Section 3, the paper addresses the proposal of a differentiation framework for maritime clusters based on a research methodology that encompasses the four key dimensions assumed to be relevant for the case of maritime clusters. Finally, Section 4 presents a discussion of the findings in terms of the distinctive factors that influence the creation, sustainable development and resilience of successful maritime clusters.

1. THE IMPORTANCE OF MARITIME SECTORS

The relevance of oceans and seas to mankind has been widely recognized within the United Nations and other international fora. The oceans cover more than 70 percent of the Earth's surface and play an important part in our lives by controlling climate and weather. They also have critical social-economic relevance. For example, the maritime regions, which house 40% of the European Union (EU) population, account for more than 40% of its gross domestic product (GDP) (CE, 2007b). The maritime economy represents five millions jobs, and about 3-5% of EU GDP comes directly from the industriesand services in the maritime sector (CE, 2007a). This figure is much higher when the indirect contributions of other sectors such as tourism are taken into account.

The world marine industry can be divided into four main areas. According to the data presented by Douglas-Westwood Limited (2005), it is estimated that these main areas had the following revenue values over the period 2005–2009:

- Services: valued at €2,454bn over the period 2005–2009 – dominated by the shipping industry and tourism.
- Resources: valued at €1,306bn over the period 2005–2009 – dominated by Fisheries and Energy.
- Manufacturing: valued at €541bn over the period 2005–2009 – mainly production of equipment for the Shipbuilding and Oil & Gas industries.
- Education and Research: valued at €62bn over the period 2005–2009 – activities associated with Education & Training and R&D for specific sub-sectors.

Capture fisheries and aquaculture supplied the world with about 110 million tonnes of food fish in 2006, providing an apparent per capita supply of 16.7 kg (live weight equivalent), which is among the highest on record. Of this total, aquaculture accounted for 47 percent. Overall, fish provided more than 2.9 billion people with at least 15 percent of their average per capita animal protein intake. The share of fish proteins in total world animal protein supplies grew from 14.9 percent in 1992 to a peak of 16.0 percent in 1996, declining to about 15.3 percent in 2005 (FAO, 2009). Fisheries in EU-27 and Norway generate an added value of €16.2 billion or 0.14% of total GDP. Employment in fisheries amounts to 444 000 persons or 0.21% of Europe's total employment (source: Policy Research Corporation).

[1] While both "marine" and "maritime" refer to sea, there is a basic difference between them: the term "marine" refers to what is born in the sea, something that is natural, which belongs to the ecosystem of the sea, while "maritime" is related to what was put to sea by man, executed by man in the sea. In the present article we refer indistinctively to the terms maritime/marine/sea.

According to data presented by EC (2006), 90% of the EU's external trade and over 40% of its internal trade is transported by sea. European ports handle almost 3.5 billion tonnes of cargo per year and more than 350 million people pass through these ports. Europe's leadership in this global industry is beyond any doubt; it holds sway over 40% of the world fleet. Approximately 350,000 people work in ports and related services which together generate an added value of about €20 billion. The perspectives for both these sectors are of continued growth, with world trade volume on the rise, and with the development of Short Sea Shipping and Motorways of the Sea in Europe. Maritime transport is a catalyst for other sectors, notably shipbuilding (in the last decade, European shipbuilding gained 43% in productivity, and has become more specialized in the construction of hi-tech vessels), along with maritime ancillary services such as insurance, banking, brokering, classification, and consultancy.

The direct turnover of marine tourism in Europe was estimated at €72 billion in 2004. The cruise industry in Europe has expanded strongly over recent years with an annual growth rate of more than 10% (EC, 2006).

The seas around Europe also provide a range of energy transport routes, via shipping, submarine pipeline networks, and electricity interconnectors, and the maritime works sector provides dredging services and land reclamation. In addition, the seas are a valuable source of energy. 40% of the oil and 60% of the gas consumed in Europe is drilled offshore. They are also important for carbon-neutral energy generation, through the rapid development of offshore renewable sources of energy and the seabed's potential for permanent CO_2-storage. European coastal waters possess many opportunities for such offshore renewable energy installations, which would make the most of the vast amounts of energy carried by offshore wind, ocean currents, waves and tidal movements. Besides the exploitation of metallic resources from the ocean floor, another emerging area is related to methane hydrates (projections estimate around 10,000 Gt carbon equivalent, which amounts to as much as all other fossil fuel resources combined). This form of energy could help diversify sources of supply and it releases less CO_2 into the atmosphere than oil or coal per unit of energy obtained.

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, for an estimated 80% of the world's living organisms are found in aquatic ecosystems.

2. STRATEGIC 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 international maritime clusters: two regional clusters (the Basque Country and the Lander of Schleswig-Holstein) and two national clusters resulting from bottom-up and top-down initiatives (the Netherlands and Norway).

I) Basque Country (Spain)

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 autonomous government to address these serious structural problems was to adopt the Porterian model of clusters that focuses on inter-industry linkages in order 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, the paper industry, manufacturing of machine tools, environment, energy, electronics and information, and automobile). The main task of these associations is 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 cluster 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 autonomous community of Spain; it represents approximately 2.5% of its GDP. In 2008 the companies involved invoiced €1,470 million in activities directly related to the sector and €2,535 million as a whole. The Basque maritime sector closed the year 2008 with 17,900 associated jobs, of which 9,300 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. This port is 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. In 2007 the movement of containers 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 that was created in 1993, and since 1999 it has been 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 on 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 pioneer in adopting the cluster approach. It integrates approximately thirty entities from among companies, associations and public institutions, which include government departments and universities. The cluster association representative of the shipbuilding sector has been strongly affected by the economic downturn that started in 2008, and it suffers from severe competition from shipyards in Korea and South China, due to their extremely low prices. The current strategic challenges embraced by the FMV include promoting among its members a culture for continuous innovation in products and organizational, business and marketing processes.

II) Lander of Schleswig-Holstein (Germany)

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 the Baltic Sea, on the east coast. The total coastline along both seas is 1,190km.

Schleswig-Holstein is a composite maritime cluster. It involves several networks within it, and these differ in intensity. Various maritime activities are well established. 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 Rotherham, and also a significant maritime financial centre that offers many insurance services.

The cluster components include: port industry, maritime logistic, shipping companies, shipbuilding and engineering services, marine equipment suppliers, maritime services, offshore technology (especially offshore wind), oceanogra-

phy and university marine science laboratories, marine and coast protection, blue (marine) biotechnology, fishing, aquaculture, and maritime tourism (aquatic sports, cruises). Shipping, marine equipment, shipbuilding and marine tourism together accounted for a turnover of €7.5 billion in 2006, and these are the most important components of the Schleswig-Holstein maritime sector.

This cluster has two important characteristics: a high intensity of R&D by firms and participation in international networks. R&D is especially strong in firms that supply equipment and components for shipbuilding sectors and in the areas of energy efficiency, environment, maritime safety, and offshore energy. Participation in international networks includes relationships with clusters from other countries (Baltic Sea, United Kingdom, Denmark, Norway, Holland, France and Poland). Several cooperation networks operate in the Schleswig-Holstein area ("Maritime Cluster Schleswig-Holstein", "German Hydrographic Consultancy Pool", "German Gashydrate Organization", "Marina Networks"), and since July 2008 a management entity for the *maritime cluster* has been formally constituted. This entity includes the Lander government, the Trade and Industry Chamber of the Lander and the Business Development and Technology Transfer Corporation of Schleswig-Holstein (WTSH) as partners, among others.

III) The Netherlands

Dutch history is inseparable from the sea. Although a small country 300 km long and 200 km wide, it is strategically located in the heart of Europe, with whom it communicates. Two major arteries – the Black Sea and the Rhine – have largely shaped 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 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, what was to become the first multinational company with shares listed on the stock exchange market was born: the Dutch East India Company.

The vocation and importance of activities related to the sea economy in the Netherlands has 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 was twice the European average.

In 2002, the Dutch maritime cluster 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.

When the Dutch Maritime Network was born in 1997 it still had a very limited cluster structure. For example, marine equipment was not yet perceived as an independent sector, but rather as part of the shipbuilding sector, while the maritime services sector was so fragmented that it was very difficult to interact with it as such. The first task of the working group who had been given the project of creating the Dutch maritime cluster was to define/ delineate the various sectors suitable for integrating in the cluster; determine its degree of relevance to the Dutch economy; assess and strengthen the inter -relationships among the various sectors; and, finally, design and implement policies that would strengthen the dynamics of entrepreneurship within the cluster. 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 sector 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 perform business activities on behalf of their members. The main function of the cluster is to lobby for its members at various levels of government: local, regional, national, and European levels, 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 the 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.

IV) Norway

The maritime tradition in Norway is ancestral. Archaeologists have found traces of vessels dating from the Palaeolithic, 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 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 attain a global scale. In the post-oil crisis of 1973, the Norwegian merchant fleet went through a process of profound transition. The aggressive competition conducted by Asian countries with lower costs imposed a great strain on the Norwegian merchant fleet. From the early eighties of the past century the global market for naval expedition came to be characterized by an excess of installed capacity. 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 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 in their countries of origin, associated with a change in taxation for companies and seafarers.

Norway has 10% of the world merchant fleet, placing it in the world ranking top 3, and it 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, of which Norway is Europe's largest producer. In 2007 the activities of the maritime cluster gave rise to 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).

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 strong R&D, involving companies, universities and public R&D centres.

Founded in 1990, the Maritime Forum, an organization that serves as a network platform linking the various sectors and their respective actors at various levels, 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 maritime cluster in Norway is divided into nine regions, and in each one of them there is a regional Maritime Forum (Oslo region, Buskerud, Vestfold and Telemark, Agder; Stavanger region; Haugaland/Sunnhordland; Bergen region, Northwest, Mid -Norway, Northern Norway). In 2007, the Stavanger region recorded the highest turnover, followed closely by the Oslo region.

A further particular feature of this cluster is related to the great importance given to evaluation and strategic planning, either as a whole or in terms of regional components, as well as to the needs and requirements of demand, competition assessment, processes, needs and opportunities innovation networks, cooperation, and certification requirements of the quality of production, and training and qualification of manpower highly specialized, among other aspects.

3. PROPOSAL OF A DIFFERENTIATION FRAMEWORK FOR MARITIME CLUSTERS

According to Porter (1998, p.197):

"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."

Gordon and MacCann (2000) have elaborated three models of clusters: 1) The model of "pure agglomeration," in which there is no cooperation between the companies because they operate in an atomized way in a competitive environment. In these cases, clustering is explained by the fact that companies want to minimize transaction costs in order to become more competitive, but there is no trust between companies or long-term relationships; 2) The model of "industrial complex" in which the location of resources and their uses are the driving forces behind concentration. This model is characterized by stable and long-term relations among companies; and 3) The model of "social networks" in which the clusters are analyzed primarily in terms of local networks of interpersonal relations of trust and institutional practices involving partnerships.

Porter 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 (1990) 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 (Porter, 1990), thus boosting growth, and encouraging competition and innovation in related support companies. Successful clusters can also significantly increase 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 (Ketels *et al.*, 2008).

Many structural properties of clusters are mentioned in the definitions and descriptions in the cluster literature. They are presented as either constitutive or complementary and can also be used to characterize clusters. The structural properties of a cluster may include (Sydow *et al.*, 2007):

- Sophisticated local customers and downstream-industries;
- Competitive related industries;
- Suppliers of complementary goods and services;
- Capable locally-based specialized suppliers of goods and services;
- Accessible financial services;
- Innovative core companies and original equipment manufacturer;
- Locally-based competitors;
- Sophisticated local labour market;
- Involvement of the local education system;
- Research and development and knowledge transfer infrastructure;
- (Trade and labour) associations;
- State actors and regional economic development;
- Critical mass of organizations.
- On the other hand, Marshall's (1890) original observation that firms can enjoy benefits by locating close to others engaged in related activities continues to hold true in advanced as well as developing countries. These benefits have been described as follows:
- The availability of specific natural resources or other unique local assets may contribute to co-location.
- Geographical proximity provides opportunities for lowering transaction costs, especially in accessing and transferring knowledge.
- Economies of scale and scope may be optimized most effectively by a limited number of efficient-scale plants in a given geographical area.
- Specialization of supply from factor markets with respect to labour, capital, or technology sources may be facilitated within a specific area.
- The means to access and share information on market and technology change may become more effective within a given area.
- The interplay with local customers triggers learning processes and more sophisticated demand.

It is widely argued that the benefits listed above have three main sources:

first, there is the potential to attract more specialized suppliers and interact with them more efficiently (Amiti and Cameron apud Ketels, 2008). Second, there is a skilled labour market that provides more specialized skills. And third, there are knowledge spillovers through different channels that one can only tap into locally (Thompson apud Ketels, 2008). There is significant empirical evidence that each of these sources matters (Ellison *et al.* apud Ketels, 2008), and their relative weights are driven by cluster specific factors.

Cluster sustainability may be affected by internal or external threats (Karlsson, 2008). The internal threats come from what may be termed 'structural rigidities'. These rigidities may develop within the cluster firms in the form of obsolete products and production technologies, but also within their economic milieu in the form of obsolete infrastructure, obsolete labour training and education, obsolete R&D, obsolete institutions and internal or regulatory inflexibilities (Porter apud Karlsson, 2008). Conservative investment policies might lead clusters to become locked-in in irreversible development paths that over time lead to a state of obsolescence. These and other cluster-specific developments, such as increasing opportunistic behaviours (Maillat apud Karlsson, 2008), can reduce agglomeration economies or increase congestion costs, thus making a location in the functional region less advantageous.

External threats include (i) *cyclical disturbances*, (ii) *fundamental technological changes*, i.e. technological discontinuities in product or process technologies, (iii) *fundamental demand changes*, such as changes in quality and quantity of demand, (iv) *cluster-competition effects*, due, for example, to reduced geographical transaction costs as a result of investments in transport infrastructure, and (v) *changes in economic and industrial policies*, for example legislation, tariffs and other trade regulations (Porter; Karlsson, Johansson and Stough apud Karlsson, 2008).

The first possible differentiation of a "cluster of the sea" as opposed to a "cluster of economic activities mainly based on land," though barely discussed among the various authors considered in the literature review conducted for this paper, if at all, may reside in a maritime cluster definition provided under the project "Europe of the Sea", sponsored by the Conference of Peripheral Maritime Regions of Europe (CPMR):

> *"…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..."*

As shown through the benchmarking examples previously presented, the birth of maritime clusters may often be traced to specific location factors and historical circumstances. Some of the maritime industries and connected

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

The cluster concept has been successfully applied in various regions, countries and sectors linked to the sea, and some aspects can be assumed to cut across these types of clusters. Although many clusters are concentrated in coastal areas, very often the maritime economy has an impact beyond coastal regions, and as a result, it is also necessary to establish relationships with stakeholders from remote areas. Often the challenges faced go far beyond the simple sharing and collaboration *inter pares* within a specific sector; usually sea clusters include various sectors already interconnected or with the potential to add value from synergistic relationships (*composite clusters*). Also important is the relevance frequently assumed in these types of clusters of the exploitation (extraction) of *natural resources* (normally used as raw materials or inputs to production systems) over time and the need for optimization, both in environmental and economical terms. *Marine and maritime spatial planning is also important* in order to regulate potential conflicts between different uses and users and preserve environmental conditions. Finally, some other factors play a key role: *Agglomeration economies,* which attract firms and resources into a particular geographical area and are characterized by a joint labour pool, a broad supplier and customer base, knowledge spillovers, and low transaction costs; *Endogenous factors* inherent to a particular cluster, which refer to the high degree of specialization usually observed (in terms of suppliers, labour and technology), the presence of multiple actors (e.g. firms, business associations, public authorities, universities and R&D centres, financial entities, etc.), a solid education and training infrastructure and evidence of dynamic links among those involved; and *Production, management and transfer of knowledge* and the carrying out of *joint research and innovation*, which are assumed as crucial elements due to the high technological and financial intensity usually linked to maritime activities.

3.1 AGGLOMERATION ECONOMIES ARISING FROM GEOGRAPHICAL PROXIMITY

This has been central to the cluster idea from the outset. Firms are compelled to locate near each other due to hard factors like external economies of scale, as well as soft factors such as social capital and learning processes. Geographical proximity provides opportunities for lowering transaction

costs, especially on accessing and transferring knowledge.

The notion of "agglomeration economies" refers to the efficiency gains that might benefit production activities in a situation of proximity and that would not exist if the activities had isolated locations. Traditionally, spatial economics distinguishes between three types of agglomeration economies (Pontes, 2005):

- Economies arising from industrial concentration, in other words, the increasing returns to scale that determine the geographic concentration of production in the same establishment;
- "Location economies" resulting from the geographical proximity between independent establishments belonging to the same industry or sector of activity; and
- "Urbanization economies", related to the geographical proximity between production establishments belonging to different industries or sectors of activity.

Marshall (1920) was one of the first economists to deal with agglomeration economies. For him they can be related to a business's cost savings that stem from the proximity to markets and to inputs (supplies, labour force etc.). More specifically, as more firms locate in the same geographic area, the production costs that can be achieved from suppliers competing for business become lower and the specialization of supporting firms and the labour force becomes greater. Furthermore, with the increase in the number of firms located in a specific area, the overall market to which a particular business can sell its goods or services increases in size.

The overall market potential of a functional region, i.e. its size and density, is an infrastructural phenomenon in itself. It changes through a very slow adjustment process and provides collective market opportunities that benefit both households and firms. 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 (Karlsson, 2008). Neto (1999) 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, and by this means the comparative and competitive inter-territorial advantages are reshaped. Once again Karlsson (2008), states that this approach is a resource-based theory of location and clustering (and trade). The critical resources must be durable in nature. They consist of natural resources on the one hand and, on the other, the supply of infrastructure in the form of facilities and networks, R&D organizations, existing production capacities with specific techniques, and the supply of different immobile labour categories. The

multiple efforts to better understand the drivers of innovation have stimulated researchers to adopt a resource-based view of the firm. They have accepted the heterogeneous character of firms and their unique choices related to strategic behaviour. In this context, knowledge is recognized as a key resource for firms and other economic agents, while both codified knowledge and tacit knowledge are pertinent aspects of innovativeness (Galindo *et al.*, 2010).

The impact of economies of scale in the form of external economies of location had already been highlighted by Marshall (1920). A given company, operating under constant returns to scale, can benefit from external economies derived from the positive externalities produced by other businesses in the region, i.e. external economies of scale (Chipman, 1970). The economies of location often play a central role in many urban and regional economic models, as well as in models of spatial product cycles.

The role of geographical proximity has been discussed in the literature concerning regional innovation systems, as well as knowledge spillovers. The view that proximity offers innovation advantages in itself begins in relatively recent times with Jaffe *et al.* (1993). The argument here is that R&D in particular constitutes a public good in locations where it concentrates and that this is sufficient to cause firms to concentrate near such opportunities for knowledge spillovers in order to be able to access them as free goods in advance of competitors.

Innovation and entrepreneurial behaviour is, as a consequence, heavily impacted or influenced by proximity conditions. While proximity is important for knowledge transmission and entrepreneurial effort, scale or agglomeration forces further amplify its effects. Therefore, large, well-integrated and relatively wealthy urban agglomerations are seen as locations where knowledge transmission is likely to be highest, *ceteris paribus*, and consequently, locations of greatest entrepreneurial action (Karlsson *et al.*, 2006). Knowledge spillovers occur when a firm creates knowledge and that knowledge produces external benefits ("spills over") onto other firms. Knowledge spillovers represent a positive externality in that the socially optimal level of knowledge is not created. This is because innovative firms do not take into account the effect of their knowledge production on other firms. The result of knowledge spillovers is that spending on R&D will be below what is socially optimal, providing possible justification for government policies to increase innovative activity. By looking at the evolution of art capitals one needs to gain insight into the origin of creativity clusters and why some clusters overtake other clusters. This question is of utmost importance for policymakers seeking to overtake other regional clusters as firms have a strong incentive to locate in pre-existing clusters to take advantage of the high level of knowledge spillovers (Karlsson *et al.*, 2004). Audrescht et al. (2006) also argue that entrepreneurship resulting from

knowledge spillovers tends to be located geographically close to the sources that currently produce the relevant knowledge.

3.2 MANAGEMENT OF NATURAL RESOURCES AND MARINE/MARITIME SPATIAL PLANNING

The current use of coastal areas is multifaceted and highly competitive. In addition, it is a source of conflicts of use for space allocation and resource depletion. This situation has highlighted the need for adequate 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 (Sørensen *et al.*, 2003). The first category concerns 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 where there are conflicting uses, 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 first explicit reference to what is known about the participation of natural resources in value creation comes from Marshall (1890), for whom "... *the agents of production are classified, commonly, in Land, Labour and Capital. By Land means the matter and forces that Nature offers freely to help the man, whether land and water, air and light and heat* ...".

It was only from the seventies of the twentieth century that scholars actually began to pay attention to the deep relations between the Economy, Environment and Natural Resources. Natural resources are all that man takes from nature to meet his basic needs. Howe (1979) states that the major classes of natural resources are farm and forest land and its multiple products and services, natural areas preserved with an aesthetic, scientific or leisure purpose, fishing in fresh or salt water, natural energy and non-energy resources, sources of solar, wind and geothermal energy, water resources and waste assimilation capacity by the set of parts of the environment.

The environmental problems that dominate the present day are the result of increasing pressure on natural resources. It is therefore essential to understand what leads individuals and society to make choices that lead to the depletion of natural resources and what guidelines could/should be used to promote their sustainable management. To answer these questions is the aim of the Economics of Natural Resources, the field of microeconomic theory that

emerged from neoclassical analysis and works with aspects related to the exploration (extraction) of natural resources over time, as well as their optimization in environmental and economical terms. This branch of economics examines the role of these resources as raw materials in the supply of inputs to production systems.

The study of natural resources economics is based on the distinction between non-renewable resources and renewable resources (Ciriacy-Wantrup, 1952). Renewable resources are those that regenerate when exploited on a timescale compatible with that of human activity (e.g. fresh water, biological populations of animals and plants, natural ecosystems, forests, rangelands and agricultural soil, solar radiation, tides and wind). Non-renewable resources are those whose extraction rate exceeds the renewal rate (e.g. fossil hydrocarbons and mineral resources metallic and non metallic). Fisher (1981) elaborates on renewable and non renewable resources. He believes that the value of the latter must take into account the fact that they are limited and not reproducible. In this sense, each unit consumed implies an opportunity cost due to their loss for future consumption. The classic work of Ciriacy-Wantrup (1952) prefigured many of the current concerns of sustainability with his development of the concept of 'the safe minimum standard'. First Ciriacy-Wantrup (1952) identifies the existence of 'critical zones' for many, especially renewable, resources, where such a zone 'means a more or less clearly defined range of rates (of flow of the resource) below which a decrease in flow cannot be reversed economically under presently foreseeable conditions. Long before a given resource is physically used up it may be "exhausted" in the sense that further utilization is indefinitely discontinued because the costs of producing any possible quantity of this resource are larger than the revenues that could be obtained from the quantity (Ciriacy-Wantrup, 1968). On the other hand, a resource may be "inexhaustible" in the sense that utilization can continue indefinitely because it is only economically feasible to use per unit of time very small amounts of resources that are available in only comparatively small physical quantities (Ciriacy-Wantrup, 1968).

Hotelling (1931), using a mathematical model to analyze the rates of exploitation of exhaustible natural resources, created a rule for the Optimal Extraction of Natural Resources (or Hotelling Rule), whereby the extraction of the resource is initially higher, reducing progressively over time (as the price increases), creating an efficient path, that is, any change in the pattern of extraction will cause a decrease in corresponding welfare. The Hotelling Rule is used by economists to understand and model the long-run evolution of prices and supplies for non renewable resources**,** stating that the most socially and economically profitable extraction path of a non-renewable resource is one along which the price of the resource, determined by the marginal net

revenue from the sale of the resource, increases at the rate of interest. It describes the time path of natural resource extraction that maximizes the value of the resource stock.

Fisheries resources are the classic example of a renewable natural resource, because they have the capacity for self-regeneration, which does not mean that they can't become depleted if exploited indiscriminately, or if there are significant changes in the environment where they develop. They are usually considered as public goods with open access (such as fisheries resources from the sea or rivers), although they can also be private (in case of aquaculture resources). The imminent risk of depletion of fishing activity stems not only from its open-access resource condition (albeit subject to regulation) and its status as common property, but also from the fact that it develops in an environment with the same characteristics. Therefore, it becomes difficult to coordinate and/or control the entry of new fishermen and prevent environmental degradation through pollution at the location where the activity occurs.

Fisheries management in practice is often relatively ineffective, particularly in exerting control over levels of catches and hence protecting fish stocks from depletion. For this reason, many countries have periodically attempted to intervene directly to reduce the size (capacity) of their fishing fleets by compensating firms for exiting the industry (through decommissioning or buy-back schemes). Fisheries are also usually subject to many regulations that are not designed to exert control over levels of harvest per se, but rather to reduce the adverse stock/environmental impact of fishing.

Fishery is susceptible to economic interaction between ownership or stewardship and sustainability, otherwise known as the tragedy of the commons. The tragedy of the commons for fisheries therefore is that the unregulated fishery resulting from the open access will eventually be reduced to a biological state at which it generates zero or possibly even negative rent. All participants will lose everything ("ruin for all"), despite the existence of an option for managing the resource on an economically optimal basis (i.e. by keeping effort at the correct level). Hardin's metaphor of "tragedy of the commons" (Hardin, 1968) presents a stark vision of the problems inherent to common property resources, i.e. resources characterized by low excludability, yet high rivalry. In other words, the use of the resource cannot be excluded, but the benefits obtained from the resource detract from other actors' abilities to obtain benefits. The metaphor seeks to explain problems related to the overexploitation of species and their resulting extinction, in which multiple individuals, acting independently and rationally consulting their own self-interest, will ultimately deplete a shared limited resource, even when it is clear that it is not in anyone's long-term interest for this to happen.

The ocean is becoming more industrialized and competition among all

marine space users is developing (Buck *et al.*, 2004). More spatial competition can lead to conflict between ocean users themselves, and to tensions that spill over to include other stakeholders and the general public (McGrath, 2004). For Pillay (2004), in the complex and conflicting situation in which resource management decisions have to be made, neither complete destruction of the natural environment nor complete avoidance of resource exploitation can be practical. A logical course would, therefore, be a balance between rational use, conservation and preservation in order to optimize man's use of natural resources on a long-term basis. Thus, multidisciplinary and transdisciplinary problem focused approaches that combine different knowledge systems (e.g. authorities, decision-makers, local communities, science, etc.) are needed to generate novel insights into the management of multiple uses of ocean space and to compliment risk justified decision making.

3.3 ENDOGENOUS CONDITIONS

Several theories have argued that specialization in a particular industry carries a cumulative process of assets and advantages, which is a direct consequence of strengthening the nature of this process (OECD, 2007). 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 (Krugman and Venables, 1990).

The natural advantages of a location provide the initial conditions for a cluster to start by providing a base for existing firms to thrive and by attracting new firms, organizations and resources. The interaction between the existing agents and the new entrants create dynamic effects that are based on the growing knowledge and resource base of the location and the development of horizontal and vertical linkages. This 'resource' starts to attract new entrants and provides strength to incumbents. Over time institutions emerge that capture knowledge, and support economic activity. These institutions can be leveraged and assisted by public support, whilst the dynamic effects are a result of individual transactions and market forces (Lowe *et al.*, 2006). In this process, clusters have become increasingly specialized 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 (Ketels *et al.*, 2008).

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, 2003). 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, 2003). The market linkages could be horizontal, as firms within an industry produce similar articles, or vertical, as some (upstream) firms supply input factors or intermediate goods that are used by other (downstream) firms producing final goods or services. Regardless of what the exact linkages might be, industrial agglomeration can be seen as clustering at an intermediate level, between households and firms on the one hand, and complete societies like cities on the other. Economic theory and practice have paid increasingly more attention to industrial agglomeration, because the economic forces behind clusters appear to be as strong and complex as they are important for economic growth and development.

The Triple Helix (Leydesdorff and Etzkowitz, 2001; Etzkowitz, 2002; Leydesdorff and Etzkowitz, 2003; Goktepe, 2003) thesis states that in addition to the knowledge infrastructure of university-industry-government relations, an overlay of communications and negotiations among these institutional partners has become increasingly important for the dynamics of the overall system. The emergent networks of internationalization, information and communication technologies (ICT), and globalization feed back on the carrying institutions so that the overlay provides competitive advantages in the reconstruction of the underlying systems. Knowledge organization and knowledge-based reconstructions can be transformed into a third coordination mechanism of social change in addition to the economics of the market and government interventions. The political economy is thus reshaped into a knowledge-based economy containing this more complex dynamics because of the evolutionary advantages of the combinations (Leydesdorff and Etzkowitz, 2003).

According to Goktepe (2003), the synergy of the three helices that compound the model of network innovation is the most efficient way to disseminate and use knowledge and enhance learning. The Triple Helix of university, industry and government does not constitute an end in itself, but it shapes new designs of innovation, both scientific and economic. A balanced positioning of these three actors is an essential component for the innovation network strategy of any knowledge-based economy.

Brett and Roe (2009) assume that the presence of internal competition is an important factor for cluster nourishment and a strong competitive indigenous environment helps the firms within the cluster to behave in a more dynamic way. The rivalry on the domestic market place helps firms to succeed

in the international markets. If firms within a cluster do not have to fight through constant innovation to maintain their customer base and market share, Porter believes that it is unlikely they will perform dynamically in international markets, and if they do not do so, it will weaken the cluster in the international arena.

On this matter, Neto (2008) observes that public policies aimed at creating territorial processes of innovation and strengthening competitiveness - i.e. policies seeking economic development and the fostering of business - increasingly rely upon intervention models that are based on coordinated action in a given local context, comprising five major strategic areas:

1) Strong investments in infrastructure projects with direct economic relevance, particularly the development of science parks, technopoles or other industrially-oriented spaces, as territorial contexts that would foster the development of territorial processes of cooperation and interaction in various dimensions, such as public-private, private-private and public-private, and the development and transfer of technology;

2) Initiatives directed to support the development of localized groupings of companies, particularly through the implementation of measures that facilitate in the local context the development of actions or initiatives to increase the collective efficiency and encourage the development of joint initiatives involving the most relevant public and private agents located there;

3) Actions to encourage the strengthening of the research-industry connections, through relationships between 'producers' and 'consumers' of knowledge and technology in order to create a territorial context favourable to the transfer and implementation of technology and knowledge;

4) Actions and regulation to encourage the development and sophistication of procedures and models of governance, aimed at the creation of a territorial context favourable to entrepreneurship and the development of economic activity, the strengthening of the collective efficiency of the territory and the increasing of local and regional competitiveness; and

5) Actions to enable relationships between each territory and respective agents at different scales, so that they can be included on the inter-territorial transnational circuits of marketing and distribution and transfer of technology.

A regional knowledge and innovation system has been defined as a dynamic and evolving constellation of actors shaped by the knowledge embedded in organizational systems and embodied in associated technological systems (Choo and Bontis apud Cooke *et al.*, 2007). Some recent studies have suggested that the diffusion of knowledge is most effective if it is organized as an interactive system, which many countries lack. Technology

and innovation are not created in isolated organizations but in favourable environments, where competent organizations and skilled individuals interact in a constructive and complementary way to assimilate existing knowledge and generate new ideas, products and production processes. It has been argued that firms and research centres of expertise/excellence play a dual role within a region, both creating (or co-creating) knowledge and absorbing knowledge from outside the region. Optimizing the potential contribution to regional development of a region's knowledge stock, however, will require complementarity between the regional knowledge base and the requirements of regional firms (for example, Gunasekara apud Cooke *et al.*, 2007).

3.4 PRODUCTION AND TRANSFER OF KNOWLEDGE AND INNOVATION NETWORKS

Economic development results from discontinuous internal changes by economic innovations that emerge from within the economic system, pin-pointing major industrial disruptions which fuel business cycle fluctuations (Schumpeter apud Backhaus, 2003).

Clusters may play a significant role in innovation. The modern approach to innovation is less linear, emphasizing the benefits of 'open innovation' in dynamic, networked environments, where organizations and institutions in different levels of a cluster interact to combine knowledge for new products and processes. A useful concept in this regard is the 'triple helix', which holds that innovation networks in clusters depend upon academic and research institutions (universities); companies, capital and entrepreneurship (the private sector); as well as favourable framework conditions (public administration). 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 this creation of linked relations that creates cluster benefits. In OECD (2007) it is stated that the circulation of knowledge in the form of an innovation system is therefore one of the key potential benefits of clustering. It is now believed that diffusion and spillovers are the mechanisms that link R&D with growth, not simply levels of R&D investment. Therefore, if the research results are not spread around the economy, then public support for research becomes significantly less productive.

In the perspective presented by DG Enterprise and Industry (2007), innovation is increasingly characterized as an open process, in which many different actors - companies, customers, investors, universities, and other organizations - cooperate in complex ways. Ideas move across institutional boundaries

more frequently. According to Noronha Vaz *et al.* (2006), 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 R&D centre is no longer relevant. Innovation can benefit from geographic proximity which facilitates the flows of tacit knowledge and the unplanned interactions that are critical parts of the innovation process. As assumed in Nijkamp *et al.* (2007), as firms become exposed to increasing amounts of tacit knowledge, probably as a result of links with new, external partners, an emerging concept reshapes the debate: proximity. This can be institutional, if national industrial specialization patterns are to be achieved, or geographical, if this is not the case. Face-to-face interaction between partners becomes a positive externality. Common links like language, codes of communication, conventions, personal contacts, past history, or successful informal interactions (Gertler; Nightingale apud Nijkamp *et al.*, 2007) take place, thereby increasing trust and reducing risk. This is one of the reasons why innovation occurs locally whereas its benefits spread more widely through productivity gains. Clusters may embody the characteristics of the modern innovation process; they can be considered as "reduced scale innovation systems". Successful clusters encapsulate all the activities needed to deliver a particular value to customers; they cross the traditional definitions of industries and of manufacturing versus services. They can emerge even where companies' locations are not determined by the location of markets or natural resources. Their specific nature, including their spatial coverage, differs according to technology, market conditions, and other factors that influence the geographic extent and relative strength of linkages. In OECD (2007) it is stated that research into the sources of productivity advantage in clusters has focused principally on the circulation of people and knowledge, the generation of innovative ideas and the development of new products and technologies. In the past, academic work considered knowledge as a public good and technological progress as an exogenous factor to the economic system that affects all companies, regions and countries in the same way. How-ever, more recent "evolutionary" theories have challenged this basic view, recognising that the generation, adoption and diffusion of new technologies is a complex process and therefore endogenous to growth models (Romer, 1990).

The processes of cluster formation, although not linear, can be described as adaptive and self-organizing in nature. These processes involve

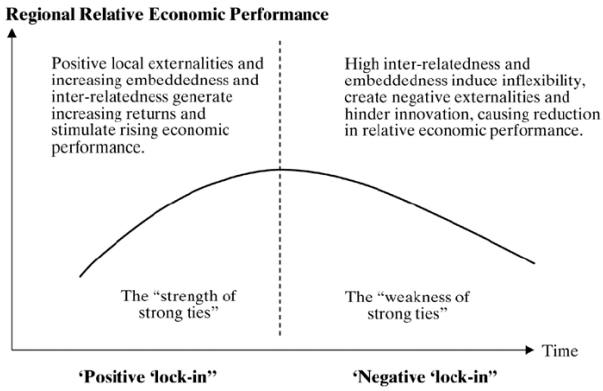
entrepreneurs as well as policy makers, and they contribute to the establishment of support functions and governance as well as tangible and intangible infrastructures, often with the aid of public funds. This implies that either the cluster or a specialized region, created as a result of the activities of entrepreneurs, tends to be unique due to its particular history (Krugman, 1991), and as such it is difficult to imitate (Feldman and Martin apud Karlsson, 2008). Depending on the success achieved by entrepreneurs, their activities will be able to strengthen the regional economic environment, including its institutions and its capital, in parallel with the increase in possibilities to take advantage of economies of scale, both internal and external, as well as the establishment of new businesses (Karlsson, 2008). Successful clusters not only create their own resources, institutions and potential, but are also able to attract resources, such as financial capital, labour and entrepreneurs from other functional regions. However, there is no guarantee that clusters that have developed well in the early stages will continue to do so subsequently. From the moment entrepreneurs start their business and acquire resources and market potential, they become a crucial factor in the dynamic process of formation and development of the cluster. Very often, new companies are created in places where entrepreneurs live and where there are established commercial and social networks, along with access to a market of potential customers and a potential supply of inputs.

According to Ketels (2008), 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 than 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.

The life cycle of industrial clusters has been the focus of a large number of research studies. One common finding is that the stages pass through emergence, growth, sustaining and declining. In the sustaining phase, the cluster is typically characterized by focused competences, open networks, synergies and use of external knowledge (Menzel and Fornahl apud Holte and Moen, 2010). In the declining phase, reduction of demand is often combined with a strong focus on a narrow trajectory, closed networks and reduced ability to change and adapt to external developments. In this phase, lobbying efforts in order to change public policy is often observed. Martin and Sunley apud Holte and Moen (2010) describe how the positive factors turn into a negative

lock-in with inflexibility and reduced innovation ability as illustrated in figure 1
.

FIGURE 1



Source: From Holte and Moen (2010)

4. CONCLUSIONS

Through the current paper, we discussed the aspects considered of most relevance towards the establishment of the distinctive set of properties/critical factors that could contribute to the idiosyncratic nature of maritime clusters and whose manifestation therefore is considered crucial for their creation and sustainable development. It was found that cooperation processes, formal and informal networks in areas such as innovation, marketing and lobbying activities, as well as recruitment and training skills are important. There is a high level of interdependence among sea-related activities that goes beyond simple geographic co-location, establishing important links and relationships within and across different sectors and actors. Cluster organizations and forums that facilitate the networked collaborations are also frequently highlighted as instrumental in maritime clusters.

What has been displayed allows us to present the following definition for maritime clusters: they are 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 institutions, related through different types of links, evolve in competitive and demanding contexts, which increases the importance of science-based clustering and favours the creation of a "fertile" environment eminently suitable for the promotion of excellence networks on research and innovation, thereby improving the structural conditions and the competitiveness factors of the sectors involved.

Is thus clear that if some differentiation exists between terrestrial and maritime clusters, the same is related to the absolutely critical role that nowledge and innovation hold in the latter as determinants for the introduction of new products, new production processes and new organizational practices, creating new business opportunities and inducing entrepreneurship, aspects that are essential to the emergence of competitive advantages for the firms and the maritime regions where they operate. In this context, the consolidation of a suitable critical mass, the creation of a specialized labour pool market based on an appropriate system of education and training, and the inter-dependence of relations established between these multiple and sophisticated actors towards the effectiveness of joint activities are decisive for the genesis and success of those dynamics, in addition to the role often played by local environmental conditions, whichrequire appropriate spatial planning for differ-rent uses and users and the sustainable management of natural resources.

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