

Maritime Clusters' Evolution: A Digital Innovation Model

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Abstract: Maritime cluster is a well-established and productively researched theme by maritime policy and economics scholars. Maritime cluster's evolution is an under-investigated area, with ramifications in maritime policy and business decision-making. In this paper, we study the evolutionary formation of maritime clusters, in the contemporary European blue economy context. We examine pertinent factors for the sustainable development of maritime clusters, with a strong technical, service and market innovation orientation. We merely examine the significance of legislative, financial, business networking and knowledge management related components. Qualitative empirical testing of the theoretical premises is performed for the Spanish, Italian, Greek and Cypriot cluster entities.

Key words: Maritime cluster, cluster evolution, digital innovation.

1. Introduction

As maritime clusters evolve over time, in terms of the composition of maritime activities performed and orchestration of associated actors and governance functions, these changing *cluster functions*, *composition* and *orchestration patterns* reflect different stages of socio-economic and trade developments, in distinct regions and time periods. Maritime clusters have been in most cases developed from port production, since their early stages, to maritime logistics or financial services and shipping management service hubs, towards technology-centered, service-centered and research and innovation-oriented ecosystems [1-5]. Extant literature discusses the evolutionary patterns for maritime clusters, primarily focusing on the change and development of port functions and maritime services [6-8]. Recent enhancements have included concepts and approaches from innovation ecosystems frameworks and have analysed cluster evolution trajectories [5, 9]. Our paper examines the evolution of maritime clusters, as related with the emergence of new economy sectors, closely interrelated with traditional maritime activities, through conceptual

development, synthesizing applicable theory, and qualitative empirical testing. Emphasis is put on understanding the interdependencies among traditional and emerging sectors of a maritime cluster, in view of the transformative power of blue economy and high technology and innovation dependent activities. *Cluster value logics* and *loci of coordination* [10], in conjunction with *cluster evolution trajectories* and *driving factors* [5] are the central elements investigated and synthesized into our proposed frame of analysis. Our study considers the specific features of the European economy context and in particular the maritime sectors of the Mediterranean Basin region. The primary premise is that a region is the locus of economic development and innovation and hence the appropriate unit for analyzing innovation systems. A broadly adopted research viewpoint, which also underpins our frame of analysis, emphasizes the perspective of the innovation process as intertwined with certain institutional, political and social contexts [11]. Innovation is a geographically defined process, whereas innovation capabilities are sustained through regional communities that share common knowledge bases, political and socio-cultural norms and values. The permeating focus on geographical territories, as an appropriate unit of analysis for an

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innovation-centered, knowledge economy, further stresses the significance of unique, non-imitable and valuable, regional resources for stimulating the systematic innovation capabilities and strategic orientations of firms.

Against this background, we postulate that a maritime cluster's evolutionary formation process may entail an incremental or a less confidently predicted and effectively influenced migration path from physical operations to new technology enabled and service-oriented maritime activities, which are supported by specialized and highly trained human capital, as well as the prevalence of digital technology and green shipping economic activities, supported by a distinct social capital tradition.

Henceforth, *evolution pathways*, as regards the clustering process, and mostly relevant with the Mediterranean Economy context which constitutes our test case are investigated by focusing on the symbiosis, competition, or mutually re-enforcing *influences between sets of sectors*, resulting in sustainably operating forms of maritime (sub) clusters of the emerging blue economy. Associated policies that promote an environmentally sustainable, technologically advanced and socially reciprocal vision of the Mediterranean region, representing more inclusively all its legitimate stakeholders, are discussed. Our paper is organized as follows: in the following section a literature review is given, whereas in the third and fourth sections the methodological approach and the CoRINThos approach are in detail presented, respectively and the empirical analysis is given in the fifth section. Future work is also sketched in the last section.

2. Literature Review

Cluster theory has been developed and adopted over the past two decades as a theoretical topic, also a policy and governance tool for thoroughly understanding, "engineering" and advancing the economic activities in knowledge-based regional

economies [3]. Clustering is primarily viewed to enhance business competitiveness, and improve socio-economic targets, such as employment and sustainability, which are also been considered as positively influenced by cluster dynamics [1]. Alternative views counter arguing on universally applicable, positive externalities of clusters also exist [2].

Maritime clusters have been defined as networks of connected large and small and medium size businesses operating in the maritime sectors, including a broad range of suppliers and maritime service providers, and associations and research and education organizations, in the maritime field, also political bodies that are all located in the same geographical area, operating and influenced by related relationships and institutions. Clustering fosters innovation abilities and embodies the transfer of new knowledge and business information, with different development functions.

The following economic activities are commonly integrated in maritime clusters: shipping, port services and maritime logistics, as well as the shipbuilding and ship repair sectors and last but not least financial and shipping/maritime services and economic activities, such as ship management services, legal and accounting services, also classification, P&I and insurance services, shipping finance, environmental management and technology, software and equipment/machinery supply. Furthermore, technological research and development activities along with education have been considered the principal services offered over of a cluster.

Up to date "traditional" maritime services have been the strategic pillars within successful international clusters, with varying emphasis and distinguishing structure and governance features provided by a cluster organization where formally operating. A number of maritime (sub) clusters are most often operating around aquaculture, fisheries and biotechnology based maritime activities, as well.

As the European maritime economy evolves over

time, we observe an overall strategic re-orientation and (re)-positioning of established and emerging stakeholders of the maritime sector, linked to an emergence of new, changing cluster forms.

In E.U. the rise of blue economy sectors, namely sea tourism (coastal and cruise tourism), blue energy (tidal, wave and other sources), seabed mining and aquaculture, maritime digital technology is a strongly advocated pathway by E.U. policy and is associated with a stronger emphasis on integrated maritime policy and spatial planning, environmental sustainability strategies, and a growing appreciation of the merits of embedding and enforcing modern technical research, innovation and knowledge transfer mechanisms in a cluster's governance and formal functions, linked with a revival in its overall attractiveness [12].

Trippl and Todtling [13] identify three types of cluster evolution paths: *incremental change*, i.e. innovation-based adjustment of mature clusters, *diversification*, i.e. emergence of new clusters in established industries, and *radical change*, i.e. emergence of high technology clusters. These (sub) clusters typically may coexist within a regional innovation system.

In Ref. [9], a thorough review and analysis of

alternative cluster evolution trajectories and driving factors is presented, including an empirical study of the Basque maritime cluster.

Valdaliso et al. [9] identify four prevailing cluster trajectories (Fig. 1), also applicable to maritime clusters evolution and sub-clusters emergence; *Maturity* (and eventual decline, adaptation or renewal); *Decline* (and eventual disappearance); clusters are not able to adapt to the technological change undergoing in the dominant industry and, consequently, they become locked-in, decline and eventually disappear. *Adaptation and/or Renewal*: Clusters adapt to the technological evolution of the dominant industry, renewing and/or transforming their knowledge base. *Transformation*: Clusters apply their knowledge base and firms' capabilities to enter into related (and more dynamic) sectors, some of them being new to the region.

2.1 The Background for Cluster Evolution

As thoroughly analyzed in extant literature [1, 14], businesses cluster together primarily because of the proximity of suppliers and customers, the presence of a large labour pool, and efficient networking. Lastly,

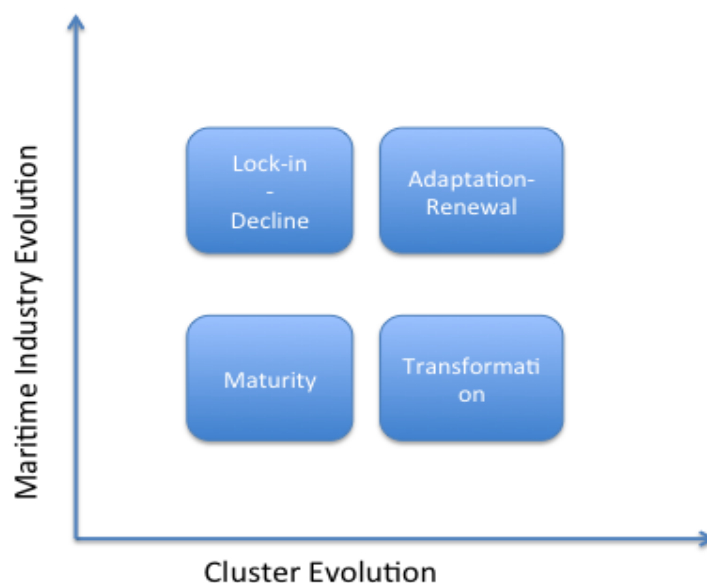


Fig. 1 Maritime cluster evolution trajectories: adopted from Valdaliso et al. [9].

businesses cluster together because of the presence of “knowledge spillovers” that enhance innovation and growth (agglomeration economies) [1]. Cluster complementarities arising from the use of common resources as well as the self-reinforcing upgrading mechanism of clusters are also important. Attaining and maintaining the aforementioned benefits of clustering requires that there are sufficiently strong linkages between the various constituent parts of a cluster.

Strong clusters are recognized by their self-reinforcing upgrading mechanisms, specifically (a) pressure for innovation, (b) complementary resources, and (c) knowledge externalities, which in turn lead to higher performance within clusters. Innovation is dependent on demanding customers, on rich and open communication between the actors in the sector, and on some level of competition between present firms as well as amongst alternative suppliers.

The performance of the cluster is measured in value added, namely “incumbent growth” and “population growth”, defined as more start-ups and entrants than bankruptcies and exits and the growth of firms in the population [1].

According to the literature review, an established framework to analyze cluster performance considers factors related to the cluster structure and factors related to the cluster governance. As regards the structural factors, cluster performance should be cited as regards a positive influence of heterogeneity; the cluster population is rather heterogeneous with regard to the economic activities included in the cluster and includes a substantial number of large firms, internationally active firms and innovative firms.

Internal competition adds to the cluster performance as it fosters specialization and, therefore, enhances, from a cluster perspective, the service to specific market segments. In many cases a balanced form of competition and co-operation is apparent.

In Ref. [15], pertinent factors that mutually

reinforce two maritime sub clusters are discussed, namely technological and pecuniary externalities.

In Ref. [9], with regard to the driving factors of cluster evolution, the authors point out a positive relationship between the size and heterogeneity of the cluster knowledge base and its possibilities to avert decline and lock-in scenarios, by adapting to the rate of technological change, renewing its resources and innovation capabilities and transforming and diversifying themselves into new sectors. Social capital, (intra and inter-cluster) knowledge externalities and cluster absorptive capacity, also have been highlighted as important sustainable evolution predictors. Finally, in the same study, public policies are outlined as pivotal to the cluster sustainable transformation.

3. Methodological Approach

Our methodological approach entails a conceptual development phase that produced the presented theoretical framework, synthesizing approaches in the research streams of innovation management and policy and maritime economics and policy, and empirical validation based on field research explained in the following section. CoRINThos¹ project constituted our basis for developing a contemporary, conceptual and of utilitarian value frame of analysis of evolving maritime clusters, whereas our test case is the Mediterranean maritime clusters, currently reassessing their technical and service innovation-orientation.

Our theoretical lenses consider the evolution dynamics and pertinent relationships between clusters' structure and governance, innovative activity and economic growth; blue economy sectors are seen as emerging sub-clusters, co-evolving with traditional maritime clusters. Our frame of analysis is synthesized from two main, distinct perspectives, addressing (a) maritime innovation modes [16], (b)

¹ <http://www.medmaritimeprojects.eu/section/corinthos>.

the evolutionary cluster dynamics and determinants of the clustering process in maritime, innovation-oriented sectors [9].

3.1 Maritime Innovation Modes

Innovation patterns are highly dependent on the sector within which companies operate, whereas the innovative behavior of firms differs in many aspects such as type of innovation (radical, incremental or recombinative), orientation (service, market, or process innovation, also business model innovation), technical innovation intensity, R&D appropriation regimes, technology and knowledge transfer patterns or technology procurement practices [16, 17].

In the same vein, the E.U. blue economy sectors, which constitute our business case basis, entail a rather broad set of markets and types of businesses with diverse structural features and innovation patterns. Cargo shipping, cruise shipping, logistics and blue energy sectors and firms exhibit different innovation modes and behavior patterns. In the following, we present the main characteristics of the four innovation modes of business within contemporary maritime clusters that we have identified, based on synthesis and insights from innovation policy and management theory and maritime policy and management studies.

(1) Mode 1: “Market-Oriented, Incremental Innovators”

Companies within this mode, such as cruise shipping companies, freight shipping companies or seaports strongly benefit from very favorable market conditions. These firms generate service and process innovations with a high ICT-content or machinery and equipment related ones, which are primarily incremental in nature, and mostly new only to this market, i.e. customer infotainment services or port community systems and autonomous vehicles for cargo handling. Nevertheless, innovation output is of high value in economic and technological terms. Of high relevance are training and marketing factors, also

regulation/legislation for ensuring stability and fair competition, as well as the financing of infrastructures, such as port facilities.

(2) Mode 2: “Value Chain-Oriented, Incremental Innovators”

This mode is the largest one in the maritime sector, including, shipping companies and shipbuilding companies. In view of rather strong competition and only average market growth, process innovations (and corresponding cost-reductions), which are predominantly incremental, are most prominent. Market innovation (entering new or niche markets, or forming strategic alliances) as well as ICT-related product/service innovation is also important. Of high relevance is external knowledge sourcing and training, regulation and fair competition measures rather than financing or marketing. The technological and economic significance of innovation output is high although, as mentioned, it is frequently based on further developments of already existing services/processes. The firms' own innovative activity strongly benefits from a wide network (high population cluster), which is spanned along the value chain, from suppliers (of software solutions and machinery/equipment in particular) and customers, with strong links to different partners in-between (consultancy firms, competitors/firms of the same industry, fairs/exhibitions, digital collaboration/social media networks, professional conferences). Institutionalized cooperation (R&D contracts, R&D cooperation) is of average importance. Large or medium sized firms are rather overrepresented in this category. In this category, the significance of growth of revenues and employment is much higher than in other categories.

(3) Mode 3: “New Technology-Oriented Entrepreneurs”

Companies within this category are expected to be highly innovative in view of very favorable market conditions and a highly qualified labour force. Based on high investments in research and development they

generate products, service and process innovation, which are of high technical standard and, in most instances, new to the maritime industry. The innovations often patented and licensed to other firms, are technology-oriented with a high ICT-content as well as a strong potential for cost reductions (i.e. maritime software, innovative, technology enabled logistics services). The firms of this mode are also exploiting a number of sources of external knowledge (universities, competitors and other firms of the same enterprise group). Medium-sized and globally oriented firms are distinctly more frequent in this mode. Factors such as financing and marketing are a prime importance for companies within this mode so that they operate sustainably. Open innovation is most prevalent in this category as opposed to in-sourced, or hybrid network models of innovation that are still prevailing in the other modes.

(4) Mode 4: "Science, Technology And Engineering-Based, Network-Integrated Firms"

Companies within this category are expected to operate within a highly favorable environment in terms of technological and science-based opportunities and market perspectives. R&D is supported by intensive use of science-related external knowledge sources as well as many institutionalized R&D cooperation (and research contracts) with domestic and foreign universities as main partners. The innovation output consists in many instances of products/processes, which are new for the industry and are protected by patents (accompanied by granting of licenses). This sector is expected to contain an above average share of globally-oriented, medium-sized and some very large firms concentrated in the sectors of blue and off shore energies, aquaculture, also ICT and equipment suppliers.

(5) Mode 5: "Knowledge Intensive Maritime Services"

Maritime management services, including ship management, banking, insurance or classification services represent a sub-cluster of knowledge

intensive business services and related innovation patterns. Growth performance in terms of sales could be expected to be above average and very strong with respect to employment. Legislative, networking and knowledge management factors are of paramount importance for their sustainable evolution.

3.2 Determinants of the Maritime Clustering Process

An archetypal lifecycle approach [18] is considered for the analysis of maritime clusters evolution, viewing the cluster creation (and evolution) as a series of path dependent stages, driven by a common underlying process. Path dependency and cumulative causation can be treated as context specificity of regional innovation (eco) systems [10, 19-21]. We examine in particular the formation process of specific maritime economy sectors' combinations, viewed as complementary and mutually reinforcing markets, operating in a formal cluster structure. Blue economy and innovation-oriented maritime clusters are seen as composed of and orchestrated on the basis of pairs or sets of sectors exhibiting positive externalities and mutually re-enforcing patterns and characteristics, exhibited in the four main innovation modes identified in the previous section [5].

We also refer to the theoretical analysis in Ref. [1], where the authors consider three interdependent characteristics that guide us in adapting the theoretical, explanatory power, also the strategic management and policy making relevance of the regional innovation ecosystem construct, in the context of emerging maritime clusters; namely value logic, participant symbiosis and institutional stability.

We build upon this model and adapt it towards analyzing how a blue economy and an innovation oriented maritime cluster create, and deliver value. The explanatory power of the innovation-centered ecosystem model lies in the ability to determine interdependencies between organizations, in specific specialization/diversification, co-evolution and co-creation of value, considering positive externalities

in bundled, complementary assets of heterogeneous participants' orchestration.

Except from a strong resource-based orientation, the explicit inclusion of market-orientation, innovation-orientation and service-orientation facets, quite different from traditional cluster analysis which focuses on the production side, further enhances our innovation ecosystem analysis for evolving maritime clusters. The dynamics of regional, socio-cultural, and political factors are treated as contextual factors of the evolutionary clustering process.

Shared values, norms and institutional arrangements affect the evolution pathways of maritime clusters through both collective institutional actions (i.e. cluster associations governance) and firms' strategic orientations and operational behaviours. Values, beliefs and organizational norms are embedded in individual maritime firms' systematic innovation capabilities.

An evolving blue economy and innovation oriented maritime cluster is thus considered as embracing those sets of sectors i.e. sea tourism, or digital maritime technology that present positive externalities and mutual re-enforcement patterns, as regards:

- *Value sourcing*, creation and appropriation for each participant entity, within the ecosystem: efficiency through scale and scope economics, innovation and externalities benefits and fair competition;
- *Participants' symbiosis* in terms of diversification/specialization, complementariness and stable co-evolution, thus capabilities and strategies enabling superior performance at both the firm level and the ecosystem level;
- *Institutional stability*, ensuring the ecosystem as a cross sectoral network of businesses operating in maritime related goods and services provision will be bundled into different resources, assets and dynamic capabilities combinations, on the basis of a legitimate and transparent locus of coordination, via active ecosystem governance mechanisms.

3.3 The European Blue Economy Context

As regards the European Blue Economy, in particular, the EU CoR (Committee of the Regions) encourages the regions to move towards "open innovation, within a human-centered vision of partnerships between public and private sector actors, with universities and other knowledge institutions playing a crucial role". The most attractive regional innovation ecosystems have been built on a strong knowledge base, a cumulative network of complementing innovation processes, and advanced combinations of innovation resources, especially human capital, funding and infrastructures. Research and innovation play key roles in Europe's recovery from the financial crisis and its achievement of the Europe 2020 Strategy targets of smart, sustainable and inclusive growth [22]. Thus, the shaping of Mediterranean blue economy sectors and the respective clusters is mostly influenced by the above policy doctrine.

According to Ref. [9], "public policies related to cluster competitiveness should foster the creation and development of *social capital* by promoting the development of collaboration through the support of cluster associations. Policies should also be oriented towards increasing the *knowledge base and absorptive capacity of clusters*, through the promotion of innovation and R&D activities (of firms and other agents of the regional innovation system) and internationalization".

Against this background, an adapted innovation ecosystem analysis, further enhances the analytical and normative strength of the maritime cluster construct, in terms of a number of dimensions that are relevant in theoretical endeavors and strategy and decision-making, today. Pertinent dimensions of the European blue economy and policy include:

- (a) An integrative approach for supply and demand, hence a "platform oriented", innovative blue maritime products and service provision model, with a mix of policy making (macro level) and strategic management (micro level) interventions and

initiatives.

(b) Provisions for a revamped collective, institutional representation and a regulatory environment explicitly centered around clusters to ensure transparent and efficient promotion of (i) political and social legitimacy of established and emerging stakeholders ("license to operate"), (ii) fair competition, (iii) measures for investments planning, in particular for infrastructures along with (iv) business competitiveness-centered actions in the new blue economy environment.

(c) Fostering awareness and social acceptance of the entrepreneurial culture and climate as regards established firms in the mature shipping sector but also start ups, exploiting opportunities for blue technologies, blue energy and biotechnology-based innovative maritime products and services.

(d) Financial tools oriented towards start-ups and high-risk technology based firms, also necessary facilitators (incubators, accelerators, financiers), beside large and established ones operating and further evolving in mature maritime sectors.

(e) Research and innovation policy for blue (emerging) and maritime (mature) economy, in tandem.

(f) Education and employment policy for blue and maritime economy skills development and job creation.

4. The CoRINThos Approach

The CoRINThos project's approach developed a methodology to dimensionalize the cluster evolution process in terms of two Factors and Targets vectors, that model and calculate the quantitative and qualitative determinants of the evolutionary clustering process. The adopted approach was deemed to validate and further enhance the developed theoretical framework.

Targets are modeled as a function of *R&D-Innovation*, *Environment Protection-Sustainability*,

Competitiveness-Comparative Advantage, *Globalization*, and *Growth-Development*.

Factors are modeled as a function of *Legislative Framework*, *Governance*, *Knowledge Management*, *Financing*, and *Networking*.

Targets' and Factors' variables are broadly, intuitively comprehensible, aimed at capturing the development process of maritime clusters, based on stakeholders' subjective assessment.

Furthermore, the CoRINThos approach adopts a Triple Helix standpoint. The Triple Helix models emphasize the collaboration between academia, industry and the public sector, where synergistic forms of research, education and innovation entities are adopted to advance the cluster dynamics and henceforth enhance the relational capital and performance of the collaborating stakeholder groups, within and across maritime sectors [23].

Against this background, based on the CoRINThos approach, we can: (i) depict maritime clusters' dynamics, identified during *a mapping process*; (ii) identify existing gaps that inhibit further development of the clusters, toward envisioned pathways, as well as pertinent and prevailing characteristics and practices; (iii) identify policy targets and enablers in terms of specific initiatives that can be implemented by stakeholders of the Public Sector, the Academia/Universities and Business Sector based on the different combination of *Targets* and *Factors*.

The final methodological outcome of our approach is the elaboration of Blue Economy Maps and Blue Economy Scenarios, as policy tools that inform concrete policy recommendations to Mediterranean and E.U. institutions, the detailed presentation of which is out of the scope of this paper.

In more detail, the main CoRINThos methodological layer prescribes that envisioned *Targets*, pursued by the evolving clusters, are enacted through policy interventions (in different policy areas), conditioned by the pertinent, (hindering or enabling) *Factors* that shape the successful operation of the evolutionary

maritime clusters. Also, by the enactment of maritime firms' strategic-orientations and innovation capabilities.

The identified initiatives articulate a combination of the five main "Targets" and five main "Factors", by addressing the changing markets conditions, emergent citizen and corporate attitudes and needs and the relevant modes of technology evolution and innovation processes and models, within the current European maritime institutional and regulatory environment.

Hence, mature and emerging maritime sectors are determined by different innovation patterns and capabilities, and henceforth different synergies between business, academia and industry are necessitated. Thus, the operation of contemporary maritime clusters, is supported through contemporary innovation ecosystems governance mechanisms and the associated composition and orchestration of stakeholders, reflecting the Targets and Factors, as per different Mode (section 3.1) and across the exemplified policy areas (section 3.3).

5. Empirical Analysis

The approach of CoRINThos project was to depict the current stage of formation and prospects of Mediterranean maritime clusters and distinct sub-clusters within, namely shipping and shipbuilding, cruise shipping and sea tourism, maritime services and digital technology firms; the framework and the empirical data have been used as a basis to formulate concrete policy instruments for both immediate and short term policy and investment decisions, at regional and national level, with a strong transnational Mediterranean Economy Framework perspective (INTERREG Europe platform).

The field research team of the study consisted of: (a) European academic experts in shipping, blue energy, maritime digital technology and innovation management; (b) one consulting company specializing in innovation and project management, renewable energies and digital technology; (c) a board of external

advisors with distinguished experts in shipping, aquaculture, fisheries, shipbuilding and maritime automation technology; and (d) a set of European maritime associations, namely chambers of commerce, chambers of shipping and maritime clusters associations, representing their members in the areas of West Mediterranean (Seville, Murcia, Balearics) and East Mediterranean (Venice, Athens, Piraeus, Limassol).

In the first phase of the project, regional and national field research studies were implemented, were data collection based on semi-structured interviews with business, public sector and academia (triple helix) stakeholders, in all blue sectors (traditional and emerging) were aggregated and processed, using a matrix questionnaire, combining targets and factors, in order to address the stakeholders' subjective views along the following main lines:

- Opportunities and Strengths: as regards positive aspects and prospects of their sector, and the further development or creation of the respective maritime (sub) cluster;
- Weaknesses and Gaps: negative aspects regarding the characteristics of their sector, that create obstacles to the operation or the creation/growth of the respective maritime (sub) cluster;
- Triple Helix Approach: recommendations, based on their experiences and best practices in their sector, in order to enhance the collaboration among Academia (Research Institutes, Universities), Business (companies operating in the sector) and State (Public Authorities), and create more favorable environment for the clusters;
- Recommendations: validation of existing/operant initiatives or policy interventions and suggestions of new ones, as regards the operation of existing or emerging (sub) clusters;
- Synergies among clusters: proposals regarding the potential synergies that could be created among cross-sectoral or/and cross-border clusters, as far as

the Mediterranean area is concerned. Also, identified opportunities for collaboration among distinct maritime sub-clusters.

5.1 The Mediterranean Maritime Clusters Case

The compilation of the aggregate qualitative data revealed that Blue Economy Clusters in the Mediterranean region are envisioned (by represented stakeholders) to entail:

- emergent sectors, namely renewable, off shore energy sources, digital maritime technology as well as new automation technology-supported shipbuilding activities (i.e. IoT for shipbuilding);
- mature sectors, namely shipping, maritime services and port centered logistics, incrementally improving, in order to meet new demands (Fig. 2).

As regards the maritime tourism sector (sub cluster), the identified evolution pathway is viewed as crucially dependent on macroeconomic and demand trends. Nonetheless an update in new knowledge management and infrastructures improvement along with integrated and non-conflicting maritime spatial planning and blue

economy policies is necessary.

Overall, the relative importance of the pertinent factors affecting a cluster's competitiveness and evolution is varying as regards the development stage (degree of cluster formation) of each sub-cluster; legislation, financing and knowledge management is of paramount importance for emerging activities and SMEs, i.e. new technology entrepreneurs in shipping, blue energy firms. For mature sectors, i.e. freight shipping, ports and logistics, networking and knowledge management are also very important, in order to enable sustainability and competitiveness.

As based on the CoRINThos surveys, we have not identified a clear and conclusive correspondence between sectors/sub-clusters and innovation modes; the four innovation modes identified are distributed quite widely across emergent and mature maritime sectors, also in concordance with the "heterogeneity hypothesis"; within sectors (sub-clusters), with common technological and socio-economic features, firms exhibit different innovation and strategic

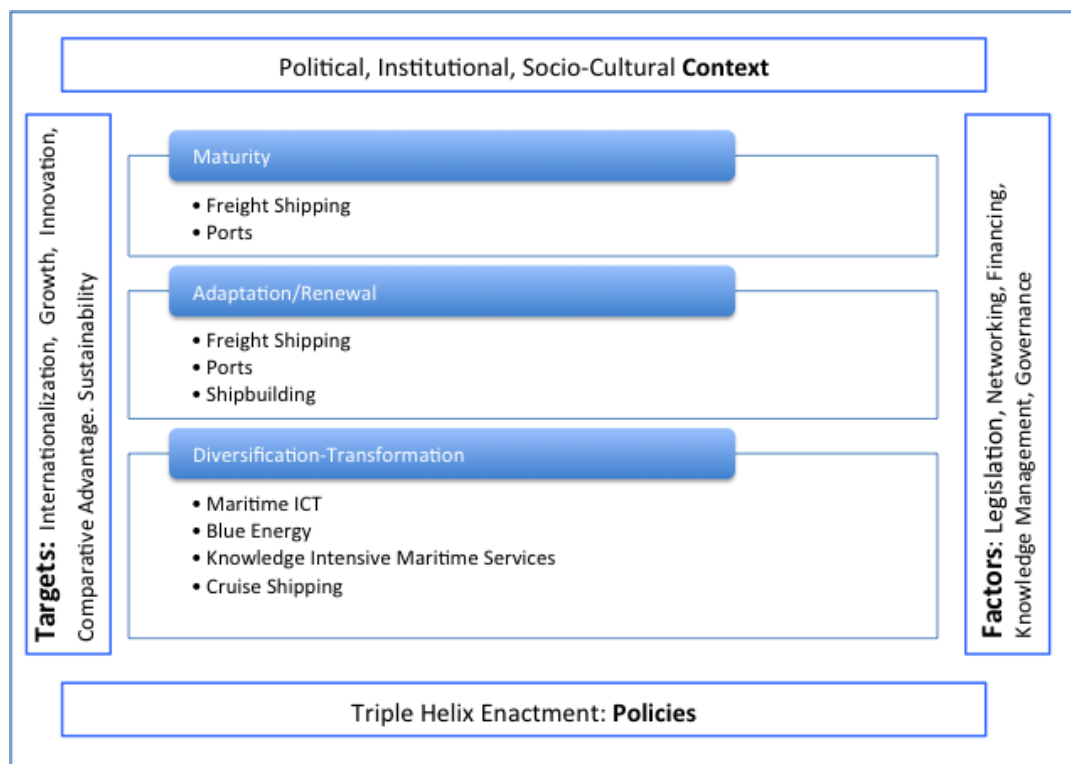


Fig. 2 Mediterranean maritime cluster evolution: targets, factors, context, and policies.

orientations. Thus, the triple helix framework (research synergies) along with detailed measures across the six policy areas highlighted (a-f, section 3.3) constitutes the proposed institutional and relational basis for efficient cluster adaption/transformation.

Technological innovation and service and knowledge oriented activities are found to receive a uniformly positive assessment. The new, digital technology-oriented entrepreneurial sub clusters, as well as the knowledge based maritime service sub cluster are identified as sectors that may constitute the main sustainable diversification outcomes of the transformation trajectory of Mediterranean clusters. A strong entrepreneurial mentality is not as uniformly validated though, through our study, attributed to a strong influence of traditional and also revamped social welfare principles and values represented in the European South professional associations, including current cluster associations.

6. Conclusions and Further Work

The diverse institutional, political and cultural characteristics of the Mediterranean Basin region, its knowledge infrastructures, innovation processes and knowledge transfer systems and traditions, as well as the heterogeneous strategic orientations of the firms operating in emerging and traditional maritime sectors constitute a complex landscape to design and enact innovation policies and business activities towards a blue, knowledge, service and digital innovation-oriented economy future.

In our paper, we examined the maritime cluster development process in the context of the European blue economy, nowadays. Our analysis is inspired and based on the CoRINThos project methodological approach, which aims at depicting the current evolutionary stage, the determinants and the prospects of mature and emergent maritime clusters and distinct sub-sectors within, namely shipping, shipbuilding, maritime services, digital maritime technology, cruise shipping and sea tourism in the Mediterranean Basin

area. Evolution pathways and determinants, as regards the clustering process, and mostly relevant with the Mediterranean Blue Economy which constitutes our business case, are considered to entail the symbiosis, competition, and mutually re-enforcing influences between sets of sectors, resulting in renewed or diversified forms of maritime activities. These will possibly promote an environmentally sustainable, socially reciprocal and technologically advanced vision of the Mediterranean region, representing more inclusively all its legitimate stakeholders. Our theoretical premises combined viewpoints and elements of maritime economic analyses, innovation management and research policy analyses, and were tested with exploratory, qualitative empirical research. Further extending and synthesizing our theoretical premises and its associated empirical validation, beyond the presented exploratory qualitative study is our future work. The testing of our model's applicability in different industrial, regional and institutional, socio-cultural contexts is central to the above endeavor.

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