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Combining Innovation Networks in Maritime & Space

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Slingshot: Unlocking Our Maritime-Space potential using Cross-sectoral Innovation Networks



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“The space sector is not only a growth sector itself,
but is the vital future enabler of growth in other sectors”

(HM Government of Great Britain and Northern Ireland, 2015)

CONTEXT

Space based technologies have been used in the marine and maritime sectors for many decades. Usage of satellite telecommunication systems have been one of the longest standing uses of space based technology in the maritime domain over recent decades, with the well-known INMARSAT established in 1979 to help improve safety at sea after a number of major disasters with loss of life. Global Navigation Satellite System (GNSS) for positioning have been used for ocean going vessels, as well as moored buoys, gliders, etc. More recently a number of satellite Automatic Identification System (AIS) systems have been launched to extend the reach of vessel positioning beyond the horizon. Since the launch of ERS-1 in 1990, in Europe there have been a wide range of usage and applications of Earth Observation (EO) related data to marine and maritime issues. However, EO services in the maritime domain, with the exception of some niche areas, remains the preserve of research scientists and state authorities, with limited uptake by private industries. Similarly, the movement of other Space technologies and approaches into the Maritime sector could be enhanced, the question being what is the most effective route towards doing so, and what actions if implemented could achieve this. At the 2013 Space Innovation Powering Blue Growth (SIPBG) conference[1] held in Cork in 2013, clusters were identified as a key vehicle which could enhance contact between the Maritime and Space sectors, and facilitate the harnessing of opportunities which arise.

CLUSTERS AND NETWORKS AS ENGINES FOR INNOVATION GENERATION AND HARNESSING

The emergence of maritime clusters is relatively new, with the majority of being established over the last 15 years. Setting up a maritime cluster is not an end in itself, but in response to more fundamental issues such as job creation and need to increase economic prosperity. Clusters can be national, regional or local in geographical extent and may be made up of different entities (e.g. state agencies and public bodies, research centres and academic units, SMEs). They can also be trans-national encompassing areas/ regions which cross national boundaries. However, most clusters form a triple helix comprising a scientific research institution (third level education establishment), a public or civic body (local / regional authority) and industry (Figure 1.1). The approach, often though not exclusively, is focused on collaborative working around the implementation of public policy that has the potential to develop and sustain business opportunities and maintain or gain a competitive edge.

Clusters by their nature are cross-sectoral. This is one of the benefits as it allows the exchange of ideas and experience across different activities. Other benefits of clusters include the stimulation of innovation and the facilitation of specialisation, e.g. maritime clusters. Moreover, the clusters in themselves create a critical mass which can be used in promotion campaigns, allow enhanced uptake of support and funding opportunities, facilitate structured exchanges between higher education, business and policy experts and provide platforms for exchange of best practise. Such enhanced collaboration and exchange leads to capacity building, niche market identification and ultimately job creation and economic development.

Maritime themed clusters are viewed as critical vehicles of implementation for European marine policy and the importance of the roles and services they can provide is evidenced by the growth in the number of maritime clusters across Europe, and the establishment of a European Network of Maritime Clusters (ENMC). At the SIPBG 2013, clusters were identified as a key vehicle. Yet questions were raised on the approaches, mechanisms and actions needed to enable clusters to perform this role.

THE CINMARS INITIATIVE

The CINMarS initiative was a response to the SIPBG 2013 call for clarity on how clusters could contribute to the animation of Space-Maritime innovation. The ESA-funded initiative aimed to identify mechanisms which could underpin a Roadmap of Actions (hereafter referred to as the Roadmap), which if applied would foster the development of stronger links and alliances between the space and maritime sectors, and spur innovation generation and development. In doing so, the roadmap authors would explore and clarify the benefits of improved maritime-space linkages such as an improved understanding of requirements, the potential for joint working, and innovation to support and increase employment and economic opportunities. CINMarS partners collaborated with members of the maritime and space communities to:

- Assess the capability of Clusters to contribute to unlocking maritime-space opportunities.
- Clarify the mechanisms and tools which need to be implemented to support innovation generation and harnessing.
- Compiling a stakeholder-led roadmap of actions to enable Clusters and their supporting agencies to drive innovation in the maritime-space intersection, and maximise the commercialisation of the ideas generated.

The research underpinning this Roadmap is available in the form of a 6 ancilliary reports (Cronin et al., 2016;, Ellingsen et al., 2016a; Ellingsen et al., 2016b; Ferreira et al., 2015; Shanahan et al., 2016a; Shanahan et al., 2016b). Please contact the European Space Agency CINMarS technical officer to gain access to these reports, quoting contract number 4000113554.

[1] http://esaconferencebureau.com/2013-events/13m23/background

DERIVING ACTIONS FOR THE ROADMAP

The analyses and recommendations which formed the basis of the actions suggested in the Roadmap are based on literature studies and qualitative data – interviews, workshop data and document studies. The CINMarS research team do not aim to make generalisations from our sample to a larger population, but use literature studies to supplement our findings and to document that the findings are more than anecdotal. The reviews are based on web sources such as national websites for innovation policy in addition to articles, books, reports, evaluations and cluster presentations.

The consultees were a heterogeneous group; consisting of top levels in the consulted enterprises, BICs, cluster and network managers, relevant actors from the business support system, and researchers in space/maritime sector. SMEs and larger companies are represented in the material as well as established companies and new / start-up companies. The selection of consultees was based on their relevance for the study and they are identified on the basis of knowledge and network. A combination of the CINMarS consortium's network and knowledge was used, along with the consultees' knowledge and network (by asking cluster and network managers, BICs contact points and some of the enterprise consultees, to recommend 1-2 relevant enterprises for interview). This sampling method has some similarities with respondent driven sampling. One of the disadvantages of this form of approach to sampling is the risk of strong bias and lack of control of the sample. In this case the consultation coordinators controlled the sample by evaluating the suggested consultees in relation to the study's needs based on available knowledge.

Bias is a challenge the consultation team encountered. Strong participation from some groups and absence from others can create bias in workshop data in that the absent do not provide data. The same too applies for the interview pool of data. By using supplementary data from document studies the authors have explored possible bias, and found that the consultee data supplements the findings. The consultee data does show that the literature-derived findings are more than anecdotal.

The interviews were conducted using a semi-structured interview approach with five themes of knowledge being sought;

- Innovation,
- ESA programmes,
- EU programmes,
- National programmes, and
- Cooperation.

To maximise harmonisation across different national pools of interviewees, an interview guide was devised. Each of the aforementioned themes had an associated group of questions which to some extent was adapted to the informant and interview situation. The use of semi structured interviews ensured that critical information points were broached during the conversation, whilst maximising the opportunities for following up relevant and useful topics that arose, omitting non-critical questions which were not of relevance for the informant.

Consultees all agreed to be acknowledged in the reports generated from their pool of interview data. However, the data, recommendations made in each of the reports contributing to the Roadmap, nor actions derived are not linked to the consultees. Consultee confidentiality was a core measure implemented, deemed crucial to maximising the participation of consultees. Most of the Norwegian data was collected using phone based interviews, except from five meetings face to face. The Portuguese, UK, French, and Irish data were collected in face to face interviews. The workshop data is based on notes from each working group and a summary of the group responses. The collected data provides, amongst others, a picture of how enterprises perceive support mechanisms.



Figure 1: The CINMarS action-derivation process resulting in this Roadmap.

The overall action derivation process is shown in Figure 1. Consultees were first interviewed or participated in the Cork (Ireland) workshop. Further information on the Cork workshop (WS1), including the consultation methodology deployed (the Technology of Participation) can be found in the workshop report. The data were compared with outputs from the literature review data, from which recommendations were extracted. A draft set of actions which could implement the recommendations were derived and presented to the consultees at the 2nd stakeholder consultation workshop held in Porto (Portugal), with action specific feedback recorded. Further information on this can be found in the workshop (WS3) report. the opportunity to feedback online was also given to consultees who could not make it to the Portugal workshop. Action-specific feedback from WS3 and the feedback received online were then used to revise and amend the draft actions. The amendment process, feedback comments and decisions are contained in an excel workbook submitted to the ESA accompanying this report. Feedback has been rigorously censored to protect consultee confidentiality effectively de-coupling each feedback comment from the comment author. These actions have then been directly inputted to this Roadmap document.

ROADMAP FOR HARNESSING THE MARITIME-SPACE OPPORTUNITY SPACE

The following pages detail a number of target actions to animate activity in the Maritime-Space arena, using Clusters as an animation engine. They also provide the context for these actions, which actions are systemic in their range of application. They focus not only on what the Space sector and the European Space Agency can do, but also on the required actions from other actors – Policy makers, funding bodies, and Clusters themselves. If required, these actions can be traced back to the recommendation, the data, and contextual information underpinning it using the traceability table in Annex A – Action traceability table of this document, and the action code provided with each action.

It must be emphasized here that the majority of actions are pertinent to a range of stakeholders with different roles and responsibilities. It is clear that identification of these stakeholders and their activities would benefit from using a three-tiered approach which include working on the macro, meso- and relational levels, and with short- medium- and long-term time horizons. This means working effectively at strategic national and international policy levels, cluster level (meso-level) and directly with companies. As an initial step to guiding implementers towards these levels, the actions have been grouped into key target areas, each with suggested lead implementers of the actions included in the context paragraph.

These groups centre on:

1. Clusters - actions which if implemented enable Cluster companies to more effectively capitalise on arising opportunities in the Maritime-Space arena. Many of these actions are also applicable to networks which could also be harnessed.
2. Policy – the principle framework which guides and directs the targeting of funding, and guides sectoral, and trans-sectoral activities at national and international levels.
3. The Space Sector – the pool of knowledge, technical experience, companies, innovators, and development capacity which is involved in ground support services for Space, Space operations, Earth Observation Applications, deep space exploration, education and scientific advancement through Space solution derivation. A subsection of this has been specifically allocated to the European Space Agency given their core role in coordinating and strategically guiding the European Space sector, and facilitating the development of national Space sectors.
4. Funding and finance – the dominant instrument through which policy is implemented and activities targeted at achieving sectoral (and trans-sectoral) activity.

Actions are designed to be easily integrated into strategy documents (guiding policy, and activity development), with suggested short-term (1-3 years), medium-term (3-10) years, and long-term (10+ years) application. Actions are also coded (e.g. P01, C01, E01, F01, and S01) for traceability. These codes can be used to trace the actions to recommendations arising from the various reports, and onwards to the contextual data acquired over the course of the CINMarS project's activities using the action traceabiity table contained in Annex A – Action traceability table Where actions are closely linked to, or build upon, each other, they are linked by the addition of a letter (e.g. C03A, and C03). Application terms are colour coded in accordance with Figure 2 for ease of interpretation.

Short term action (1-3 years)	Medium term action (3-10 years)	Long term action (10+ years)

Figure 2: Colour coding for Action terms

CLUSTERS – ENGINES FOR INNOVATION

The CINMarS project was specifically tasked to examine the potential role of Clusters (see Figure 3) in animating the Maritime-Space innovation sector. In doing so, it has extracted a high number of key actions addressing how they can restructure architecture, revise procedures, and refocus activities, to better position themselves to harness the Maritime-Space opportunity arena. Implementing these changes will not only benefit Clusters themselves, but also improve their member company's capabilities to respond to opportunities, and animate idea generation, and commercial exploitation.

It must be emphasized here, that implementing the following actions in Clusters requires a strategic mind-set, focused on advances in the medium term, whilst implementing actions in the short and medium term. It must also be recognised that modifying Clusters is only part of the solution. In order to animate the trans-sectoral space effectively, coordinated actions must also be taken by the Space Sector, Funding bodies, and Policy makers. These are needed to foster market and social frameworks within which Clusters can operate as the required innovation engines.

The following actions are primarily for Cluster leader companies, involving close consultation with the Cluster's constituent triple helix partners, and member companies. For networks, selected actions are applicable depending on network maturity and whether development into a tangible Cluster architecture is desired, or even required.

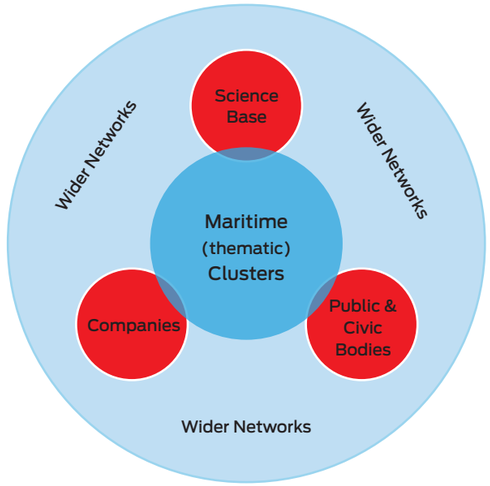


Figure 3: The triple helix structure of many maritime clusters, embedded within the constituents knowledge and business networks.

Strategic development which targets cross-sectoral opportunities

CLUSTER STRATEGY, STRUCTURE AND DEVELOPMENT

Derived strategies need to establish the intent to seek opportunities in the Maritime-Space arena, and multi-disciplinary and trans-sectoral solutions. Development of these strategies should also be an exercise in critical Cluster evaluation and appraisal, identifying principles which need to be established to achieve the actions outlined below. As noted in Ferreira et al. (2015), every Cluster and network is different, with the extent to which the below actions apply differing. All require evaluation and examination to see which of the below apply, and the foresight and plan to implement those actions which do.

Action	Action Code	Action timeframe
Set short, medium, and long term expansion goals in cluster strategic plans.	C01	Short
Devise and Integrate an iterative review process into their 5-year (minimum) strategic plans, ensuring that review involves an element of assessing whether the Cluster/network can cope with organic development, and incorporating a programme of actions and viable indicators to monitor progress.	C02	Short
Review management plans to install mechanisms that ensure their activities do not conflict with those of participant companies. If they potentially do, mechanisms must be installed which ensure efforts are made to agree a mutual understanding on a synergistic way forward that does not damage the trust upon which the Cluster is founded.	C03A	Short
Devise and implement corrective structures, procedures and mechanisms.	C03B	Medium
Devise measures to entice the integration of new companies in a strategic manner, aligning with cluster priorities as outlined in their strategic plans.	C04	Short

Devise procedures and implement them to enable the cluster to call for involvement of companies in key gap areas.	C05	Short
Implement measures to entice the integration of new companies in a strategic manner, aligning with cluster priorities as outlined in their strategic plans. Plans must also account for the potential to refuse membership.	C06	Medium
Incorporate as a goal in the cluster and network strategy - to ensure that the developed entity shall constitute a real entity, in a real location with real people and real funding, using integrated voluntary and virtual aspects to enhance the core network/cluster presence and capabilities, devising measure to achieve this.	C07	Short
Include physical infrastructure development goals, with targets set for securing development funding into Cluster Development Strategies for physically located clusters.	C08	Short
Incorporate an element of developing a company-hosting space within their development plans (for clusters with an evident physical hub location).	C09	Short
Assess levels of academic input to the cluster's knowledge base, whether this aligns with the Strategic goals, and whether improvement of this aspect is required	C10A	Short
Devise and Implement corrective measures	C10B	Medium
Confirm that where clusters exists about a physical Cluster location, development strategies for the Cluster area remain conscious of: - Preserving peoples capability to move around and use physical spaces to innovate or converse with fellow innovators - Providing physical spaces and activities for innovation-generating conversations to occur.	C11A	Short
Devise and implement corrective measures.	C11B	Medium
Clarify the cluster leadership organisation, ensuring it is clear and concise with clear contact points, and role allocations to key individuals on the Cluster management team.	C12	Short
Examine cluster management structures, reviewing whether the intra-cluster communications infrastructure and activities adequately ensure that the leader can act to balance cluster interests and partnerships and target them towards the clusters strategic goals.	C13	Short
Establish communications channels with Local, regional, and national Authorities to involve them in the Cluster Development process, and align with national to local policy and strategy.	C14	Short
Develop (iteratively with SME's and Cluster leaders) and incorporate a specific goal and targets into Cluster and Network strategies focused on engaging with SMEs and growing SME involvement in the Cluster / Network.	C15	Short
Implement an intra-cluster /intra-network communications infrastructure, which enables the cluster leader to receive information on possibilities and balance the demand for collaboration by cluster members with strategic growth in the Cluster and intra-cluster networks.	C16	Short

TARGETED LOBBYING SUBJECTS, AND NICHE DEVELOPMENT OPPORTUNITIES

Clusters can consult and collate the views and concerns of the innovators and companies they support. They are also well positioned through their often exhaustive outreach and network-building efforts, to be knowledgeable about market need, and upcoming opportunities. Such information needs to be communicated to policy makers through targeted lobbying, ensuring that the potential for Clusters to animate economic activity remains in the policy makers mind-set.

Action		Action Code	Action timeframe
Targeted lobbying subjects and development	Develop lobbying strategies with regard to calling for sensible data hosting solutions.	C17	Short
	Implement the lobbying strategies calling for sensible data hosting solutions.	C18	Short
	Lobbying and awareness raising of government departments could be encouraged by both the maritime and space sectors to include cross sector collaboration.	C19A	Short
Niche development opportunities	Develop a system to monitor the alertness of watch keepers at sea	C19B	Medium

Support services provided and future service development

DEVELOPING A CLUSTER THAT LIFTS

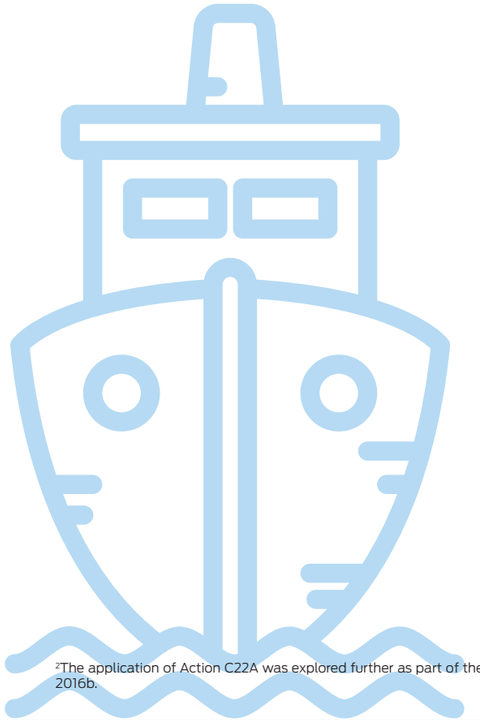
In positioning itself at the core of a network of companies and innovators, Cluster leaders are best positioned to coordinate and deploy targeted supports which help companies address their skills and knowledge gaps, and leverage their networks to enhance their capabilities.

Action	Action Code	Action timeframe
Develop and implement a clear set of Cluster Support Services, with a dedicated team, which align with attainment of the Cluster's strategic goals. These services should be allocated to a central Contact point and with a clear outline of roles and activities.	C20	Short

DEVELOPING STAKEHOLDER AND MARKET ENGAGEMENT SUPPORT SERVICES

A key element of a Clusters set of support services should be focused on building company connectivity to markets; this can be critical during the product design phase of development, or during the acceleration phase in expanding the company's customer base. Where a company has a skills or capability gap in being able to do so, a dedicated stakeholder engagement or market engagement support service, with funding to train and deploy selectively would be beneficial.

Action	Action Code	Action timeframe
Design a framework, structure, and scope of activities for a Cluster-specific Stakeholder Engagement Service, and Network Contact hub. Key points to be addressed are: (i) why be involved - incentives and track record of being involved in joint sectoral activities, (ii) activities to attract members, (iii) activities to retain members.	C21	Short
Develop stakeholder engagement services and network contact hubs, to effectively link SME's, or support SME's in linking to target markets and key audiences. Targeted activities to achieve this include: (i) using existing mechanisms/structures, and networks where they already exist, (ii) devising or developing new internal cluster mechanisms/structures, and networks where they do not, (iii) Conducting information days, which couple as networking events within the cluster.	C22A[2]	Short
Task stakeholder engagement service teams (people involved in implementing the SE service) to capitalise on existing networks, and capitalise on existing and new technologies (e.g. social media advances).	C22B	Medium
Ensure that engagement approaches follow best known practices, and where appropriate deploys new developments in engagement technology (e.g. social media).	C23	Short



[2]The application of Action C22A was explored further as part of the CINMarS Validation Exercise (VE) activity, namely under VE1. Full details can be found in Shanahan et al., 2016b.

DEVELOPING GO-TO HUBS OF INFORMATION ON FUNDING AND OPPORTUNITIES

Every day spent not working on product and business development, is a day not spent earning for an SME. As such, finding out information on funding, and navigating/translating funding portals constitute a demand on the resources available to businesses. Here, Cluster support services could be targeted, developing easy to use decision tree tools, distilled knowledge on funding and business development process, and go-to contact points who know other actors in the same Cluster and beyond the innovator needs to contact for relevant aid.

Action	Action Code	Action timeframe
Engage with funding agencies and invest in developing a knowledge service, building on the availability of national and regional services in existence, and linking SME's and innovators to information on: - Market networks, - Skills networks (SME's, researchers etc.), - Knowledge services (National Contact points etc.), - Financial supports and mechanisms, - Processes to develop an innovation into commercial products.	C24	Short
Appoint central contact point(s) - "matchmaker(s)"- within the cluster who has the knowledge and information available to facilitate connections	C25A	Short
Implement an active, and accessible contact point, with in-depth knowledge on the skills currently within the Cluster / network. These contact points should be trained in: (i) the practicalities of applying for ESA, EU and national funding mechanisms, (ii) matching innovators to funding and supports, (iii) communications and engagement, (iv) the Space and Maritime sectors in Europe, (v) companies, skills and goals of the cluster.	C25B	Short
Develop a distributed database of information to support the Cluster Support Services team with practical relevant knowledge.	C26	Short
Develop a clear set of priority areas to guide their engagement with other sectors and source solution teams.	C27	Short
Develop a decision tree decision support tool, and underpinning HR capacity, which can quickly and effectively allow the Cluster leader to guide the innovator to the funding mechanism best matching their needs, and help them tailor their idea to suit.	C28	Short
Identify and implement activities which ensure Cluster leaders and support service operators are acutely aware of market needs, to guide SME's and larger participating companies to opportunities.	C29	Short
Develop a standard of response and query processing for queries received by the KTPN's and Cluster Support Services contact points.	C30	Short
Develop a dynamic cluster-audience-targeted online information service and contact point within the Cluster, to inform companies and innovators on opportunities and paths to explore and incorporate Space applications and technologies, key contacts etc.	C31	Medium
Enhance the Cluster-audience-targeted online information service with a capabilities map (containing locations and capabilities of companies), and access to more informal newsletter and email information services.	C32	Short

INCENTIVISING CLUSTER/NETWORK ENGAGEMENT

Expansion in the SME content of Clusters is desirable as a diverse pool of SMEs enables greater flexibility to respond to opportunity areas (such as those arising in the Maritime-Space arena). However, moving into a Cluster or Network and participating in activities must be of benefit to a company. Specifically, with Clusters, co-location is sufficient benefit, but often there are a range of other, unrealised aspects which increase the benefits. These include access to training, access to experiential knowledge, and access to knowledge supports. These benefits can be improved using targeted activity and funding applications, and examining the advantages of participation to provide information to prospective companies.

Action	Action Code	Action timeframe
Implement a series of active and targeted engagement and training activities with the Space (or other) target sector, with a strategic approach aligning with Cluster / network priority areas.	C33	Short
Incorporate an element of business development and innovation development advice into the main Cluster Support services Funding agencies and enterprise support bodies to play a role here - vouchers for capacity building, funding for mentoring networks, communities of good practice, decision trees to suitable mechanisms.	C34	Medium
Identify and implement activities through which Cluster leaders and support service operators support the development of new markets, and the generation of markets for new innovations which are not developed in response to market need, but in response to a novel opportunity. Such opportunity development could be fostered through the use of Technology transfer drives, secondments from alternative sectors etc.	C35	Short
Develop and provide meeting spaces, with free use for Cluster members as a benefit of being a participant company.	C36	Medium
Clarify the advantages for SME's involving themselves with the Cluster, and distil into a "Why bother?" information brief for prospective SMEs.	C37	Short
Identify key ambassadors within their companies, or key external ambassadors, and involve them in showcases to the cluster/network membership.	C38	Short

Building trust for multi-disciplinary opportunities, products, and services

ENABLING MULTI-DISCIPLINARY TEAMS FOR SEIZING MARITIME-SPACE OPPORTUNITIES

Flow of knowledge inside an organisation and across organisational borders is dependent on openness and collaboration; this presupposes trust (Ellingsen 2016). Trust and trust-building are a basis for openness and collaboration inside an organisation and are a platform for external collaboration, such as that needed for companies to cooperate synergistically within a Cluster. A strongly emphasized concern from CINMarS consultees concerning Cluster participation focused on the potential for intra-cluster competition to build and remove the potential for synergistic benefit. To this end, a number of measures emerged from the analysis undertaken during CINMarS, which if implemented could not only foster trust and openness, but in doing so foster mutually (and even synergistically) beneficial cooperation between cluster companies, and between Cluster companies and the Cluster leader. It must be noted that trust and cooperation are very difficult to build, and very easy to fragment. In recognition of this actions involve the establishment of principles, MOUs and in the medium term structures and procedures to reduce the impact and likelihood of a conflict of interests.

Action	Action Code	Action timeframe
Establish a Cluster /network participant set of principles (mutually recognised service levels) or Memorandum of Understanding (MOU).	C39	Short
Include a commitment to showcase SME successes into the Cluster leader responsibilities of the MOU.	C40	Short
Establish a clear set of commitments (service level commitments) to each other on behalf of the Cluster leaders and Cluster members, which formally recognises Cluster membership.	C41	Short
Devise and develop structures and procedures that build trust amongst Cluster participants.	C42A	Short
Establish structures and procedures that build trust amongst Cluster participants.	C42B	Medium
Scope and examine the concerns of SME's and potential Cluster-specific measures which can address them.	C43	Short
Ensure that the Cluster ethos of openess and knowledge sharing does not threaten SME IP.	C44	Short
Implement appropriate SME IP protection standards and measures.	C45	Short
Support the development of external networks outside the cluster.	C46	Short
Establish process for feedback from cluster members who have engaged with these external networks, to shape Cluster strategy and priorities.	C47	Short
Create cross sectoral multi-disciplinary teams with a moderator between the different sectors to enable both sectors to communicate effectively	C48	Short

POLICY – FRAMING THE INNOVATION ENVIRONMENT

A coherent, and supportive policy framework can provide a clear set of principles within which legislation, funding, and activities to support Clusters (and networks) to animate the Maritime-Space arena can be advanced. These policy frameworks should feature key characteristics:

1. developing nationally relevant (and European aligned) goals or targets, for the Maritime and Space (or other) sector to respond to,
2. encouraging the application of trans-disciplinary and trans-sectoral solutions to issues arising in the Maritime sector (and vice versa),
3. providing flexible principles within which adaptive funding mechanisms can be derived and deployed, responding effectively to the rapid pace of opportunity/need identification,
4. enhancing the availability of information available to innovators, on the target sectors, opportunities, and funding possibilities to harness their Maritime-Space innovation.

FRAMEWORKS FOR KNOWLEDGE AND TECHNOLOGY TRANSFER, AND INNOVATION ACTIVITIES

Given its critical role in establishing a framework within which innovation can be animated, the implementation of policy measures, and the establishment of policy principles should not be done haphazardly and on an ad-hoc basis. To this end, it should be coordinated using national and international strategies. It is encouraging that this is recognised in the European Space Strategy[3] – *"The space sector needs to be better connected to other policies and economic areas at EU level and in all Member States."* However, now the challenge is for such recognition to be implemented in other sectoral and economic policies at EU and member state levels. For Clusters to effectively animate the Maritime-Space arena, this requires national Space strategies which (i) complement those Maritime strategies already being implemented, (ii) recognise the potential for Clusters (and networks) to contribute, and (iii) ensure coherency exists across the two strategies. As such, not only did the CINMarS research recommend that strategies be derived for every member state within ESA, but also, that these strategies highlight the desirability for certain principles to be integrated into strategies. Namely, these include the principle of promoting trans-sectoral solutions, and trans-sectoral pollination of technology and knowledge, and building strategies on the basis of viable structured engagement with the Space sector during strategy development. This ensures buy-in, and readiness of the sector to capitalise on strategy publication. Such principle establishment is a long term commitment, which requires short to long term actions to achieve. These are outlined below and require the attention of national and EU-level policy makers, in close coordination with the European Space Agency, Cluster leaders, and key sectoral (both Space and Maritime) stakeholders and representative groups.



[3]Space Strategy for Europe
Communication form the Commission to the European Parliament, the Council, ahte European Economic and Social Committee, and the Committee of the Regions, COM(2016) 705.
https://ec.europa.eu/transparency/regdoc/rep/1/2016/EN/COM-2016-705-F1-EN-MAIN.PDF

Action	Action Code	Action timeframe
Devise national Space Strategies where national strategies are absent, ensuring these strategies incorporate an element of stakeholder-driven action derivation, ownership of actions, and "Responsible Research and Innovation approaches" included. (Stakeholders consulted should at a minimum represent industry, regulators, technical, financial institutions and research centres)	P01A	Short
Monitor and review successes / challenges	P01B	Medium
Promote multi-disciplinary and trans-sectoral solutions where possible in existing and new Space and Maritime strategies and industrial policy	P02A	Short & Medium
Incorporate strategic actions which drive communications and outreach, to support the generation of trans-sectoral innovative solutions that address societal needs and markets	P02B	Short & Medium
Ensure the Integration societal actors (researchers, citizens, policy makers, business, third sector organisations, etc.) into every stage of the research and innovation process (funding mechanism development, call development, proposal assessment, project implementation, project appraisal) in order to better align both the process and its outcomes with the values, needs and expectations of society and markets.	P02C	Short & Medium
Monitor and review successes /challenges faced by societal actor integration,	P02D	Medium & Long
Ensure that strategies recognise the need and advantages of basic data to be freely accessible, available in the long-term, with derived solutions and technologies being affordable as a fundamental principal.	P03	Medium

FRAMEWORKS TO ENSURE ADAPTABLE, TARGETED FUNDING CALLS

The implementation of policy principles is often achieved using the targeted application of funding. With this in mind, recommended actions derived from the CINMarS pool of activities which address the policy-level stages of funding call development, and objective establishment, have been collated. These should be conducted in close coordination with actions outlined in the Funding and Finance section of this Roadmap, by policy makers at national, and European Union level, with the support of the European Space Agency, and national and EU funding coordination bodies. Given the potentially rapid pace of change in priorities, only short and medium term actions are proposed. It is assumed that iterations on the development of these actions shall continue into the long term to enable revised principles to be applied.

Action	Action Code	Action timeframe
Ensure future funding rules and procedures can adapt and respond to changing circumstances (for example currency volatility resulting from Brexit).	P10	Short
Identify gaps in public funding and key priority topics. Assess in particular the opportunities in Green Shift, environment, transport, and logistics.	P11A	Short
Develop funding calls which address these gaps.	P11B	Medium
Incentivise SMEs to develop information material on their space-derived solutions which can be disseminated at space solutions showcases, and attend if possible - examine EU and national funding mechanism rules ensuring that such promotion for the wider sector is funded through an appropriate mechanism and deemed a risk by an SME.	P12	Short
Scope the potential to direct funding towards the development of, or facilitating access to, situational awareness infrastructure/environments which can allow the testing of satellite-derived information products and hybrid solutions, and their utility in terms of situational awareness and fast-paced decision environments.	P13	Short

ENHANCING CAPACITY TO PROVIDE CLEAR INFORMATION TO INNOVATORS

The provision of clear, concise and contextual information on the funding options available to Clusters, SMEs and Innovators is an essential component of maximising the impact of funding mechanism modifications. A critical role is conducted here by National Contact Points (NCPs). In this report, the NCP refers to the person allocated with national responsibility for disseminating information on international funding calls from various sources. During CINMarS consultations, the potential for NCPs to perform an enhanced role in providing this information arose. The current efficacy of NCPs in raising awareness of funding opportunities, or being suitable go-to points for knowledge and guidance varied widely. In order to address this, it is clear that occasionally NCPs may need to receive training in how to be an effective NCP to refocus their efforts more efficiently. This involves furnishing them with the requisite skills in knowledge, communications, and network building the role entails, building upon their strengths and addressing any weaknesses.

Enhancing these critical roles also involves sectoral support being generated and made available to the NCP, *establishing and effective and productive NCP-sector-funding agency web of communications.* The establishment of this web is also dealt with by target actions in both the Space sector, funding, and European Space Agency sections of this Roadmap. In deriving actions from the CINMarS data, it is clear that the potential of National Contact Points (similarly to ESA Business Incubation Centres) is under-appreciated, and they could be insufficiently resourced to attain this potential. This is an area that requires further investigation and clarification. Furthermore, there is also scope to investigating how NCPs can be resourced properly to conduct NCP business in a transparent and responsive manner. The target actions below require involvement of National agencies, with the support of national, European Union, and European Space Agency policy makers and policy implementers. They encapsulate the process of engaging with National Contact Points, assessing their needs in terms of resources and training to achieve this potential, and providing the identified resources and training.

Action	Action Code	Action timeframe
Enhance National Contact Point's knowledge on the Growth potential of the Space Sector, and the inherent challenges and opportunities stakeholders face, ensuring dynamic communication between SME and other stakeholders (Academia / agency etc.).	P14A	Short
Support training implementation of NCP's where needed, equipping them with key knowledge on their sector of responsibility, and key communications skills in distilling and delivering information to a range of target stakeholders.	P14B	Medium
Review the performance/appropriate skill levels of National Contact Points (NCPs).	P14C	Short
Implement training to upskill NCPs where needed.	P14D	Medium

ENABLING CLUSTERS TO ANIMATE ACTIVITY IN THE M-S ARENA

The above actions, if implemented, build a framework within which innovators and companies can more effectively identify opportunities, and exploit them through commercial developments, facilitated by their presence within a Cluster, or membership of a network. However, there are also a select number of measures which would equip Clusters with the capability to responsively target companies to seize opportunities arising in the Maritime-Space arena. The majority of these are short term actions, bar one (P05) which requires a medium-term perspective to be taken, allowing it to harmonise with ESA BIC appraisal and potential remit modifications which arise from the ESA actions.

Action	Action Code	Action timeframe
Encourage established clusters to expand to include cross sectoral collaboration between the S/M sectors	P04	Short
Support maritime (thematic) clusters to become part of an ESA BIC	P05	Medium
Identify the challenges faced building academia-SME links, and stakeholder-project team links, through policy and funding mechanisms, devising appropriate mechanisms or mechanism modifications to address these challenges	P06	Short
Review whether strategies specifically recognise the importance of providing meeting spaces and opportunities for both sectors to interact at a face-to-face level	P07[4]	Short
Recognise the strategic potential for Clusters and Networks to contribute as hubs for outreach and communications activities, and facilitators of information exchange opportunities and forums.	P08[5]	Short
Ensure the inclusion of policy-makers / government representation on cluster advisory boards, to ensure their involvement with strategy and dialogue	P09	Short

[4]The application of Action P07 was explored further as part of the CINMarS Validation Exercise (VE) activity, namely under VE3. Full details can be found in Shanahan et al., 2016b.
[5]Aspects of the application of Action P08 were explored further as part of the CINMarS Validation Exercise (VE) activity, namely under VE1 and VE3. Full details can be found in Shanahan et al., 2016b.

SPACE – OPPORTUNITY-DRIVEN SOLUTIONS

For the Maritime sector, Space is, as mentioned above, comparatively unknown as a relevant collaboration sector. Access to the sector (in order to support collaboration) was raised as an issue. For this to be challenged, requires the sector to be pro-active; for example, promoting how space technology and solutions can contribute to solve a broad spectrum of societal challenges. The CINMarS consultation revealed that the space sector needs to address the challenge of making themselves relevant as a solution source, clarifying not only what is on offer (and the full scope and scale of what the space sector represents), but also how to engage with the sector's key network, and agency gateways, to fast-track interested business to likely partners.

To do so, the space sector has to develop targeted strategies and programmes. These include programmes for idea and concept development, for identification of technology gaps, and identification of technology sources. There should also be programmes targeting realistic and viable user involvement in these processes. The CINMarS research has revealed not only the scope of the space sector, but also reinforced its scale. In Europe, the European Space Agency (ESA) are clearly the dominant stakeholder for coordinating and targeting developments, however it also highlighted that they constitute only a part of the sector. The ESA do not design and build the solutions, or educate the innovators of tomorrow. They coordinate and support companies to do so, and facilitate the realisation of these goals. As such, the two are presented as being separate here, yet it must be noted they are highly interlinked. The ESA is highlighted as the dominant facilitation and coordination element, the wider space sector as the innovation generation and harnessing element.

ESA - Coordinating the unlocking of space uptake potential potential

The European Space Agency (ESA) is the core coordinator of Space activity across Europe. In setting a unified space and related industrial policy, recommending space objectives to its Member States, and integrating national programmes into the European program, it constitutes the hub of European space activities. Advancing these European goals can have a marked impact on lifting ESA member states space sector capacity. Target actions by the ESA are capable of having long term activation effects in member states and thematic sectors. The CINMarS-derived actions operate within this framework, enabling the ESA to support member states in leveraging their Clusters to enhance and harness Maritime to Space opportunities. There is a clear conclusion from CINMarS that ESA needs to accompany their strategic, policy, and funding modifications, with targeted investments in their external communications frameworks and activities. All of the actions outlined in this section are recommended for implementation by the European Space Agency, in coordination with the wider Space sector, European Commission, and ESA member states where deemed appropriate.

HIGHLIGHTING STRATEGIC OPPORTUNITIES, AND FACILITATING NATIONAL PRIORITISATION

In coordinating the efforts of 22 member states, the ESA has the experience and background to lobby for the generation of national space strategies, and the experience to advise during their derivation and implementation process. The Agency also has a wealth of experience in available technologies and advances in the Space sector which are ready for transfer across to other sectors. As such, the ESA are very well positioned to coordinate the space sectoral response to European sectoral policy releases (e.g. such as Blue Growth, and the Atlantic Strategy), highlighting formally where the Space sector can contribute to target achievement.

Action	Action Code	Action timeframe
Derive an advisory strategy for updating every member states Coordinated Space Efforts.	E01A	Short
Foster the derivation of national strategies, where member states respond positively to the advisory strategy.	E01B	Medium
Monitor and review successes / challenges	E01C	Long
Establish the mechanisms and responsibilities needed to enable individuals/teams within ESA to read, and highlight Space opportunities in newly released / soon-to-be released national and international strategy documents, and prepare an official response outlining these opportunities.	E02A	Short
Implement this response-to-policy mechanism	E02B	Medium

EXAMINING THE REMITS OF ESA BIC REMITS AND THEIR ENHANCEMENT POTENTIAL

European Space Agency Business Incubation Centres (ESA BICs) have been highlighted by this research as being a potentially crucial part of the Cluster animation solution. The CINMarS research highlights the opportunity for ESA BICs to expand their remit to become in addition crucial hubs of information and outreach in Member States and business networks within which they are located. The key point here is BICs could take advantage of their fortuitous co-location with non-space business incubation clusters (see Figure 4). This is discussed in more detail in both Ferreira et al. (2016) and Ellingsen et al. (2016b), originating from a spatial study reported on in Shanahan et al. (2016a). Through supporting ESA BICs to operate within non-space business clusters, such a step would capitalise on the brand associated with ESA BICs. It would enable non-Space actors to harness the range of technology solutions in the Space sector which have potential applications in the non-Space sector, and create enhanced dialogue between the Space and non-Space sectors within an already operating, and highly-regarded, ESA framework.

In their current form, and with their current remit (scope of contractual obligations and remit of activities), ESA BICs are not resourced or capable of conducting the role this Roadmap envisions. Suggested actions here have a long term strategic goal – to enable ESA BICs to integrate with thematic clusters, and conduct outreach and engagement activities which generate a pull in other thematic sectors for space-derived solutions. There are a number of required short- and medium-term actions which would need implementation to realise the envisioned long-term enhancement of selected ESA BICs. Such implementation would require the iterative engagement with stakeholders and contractors involved in the selected BICs, and capitalise on the already existing monitoring and reporting frameworks in place between ESA and the prime contractors.

The advantages of beginning with the Maritime sector have been highlighted in Shanahan et al., 2016a, who have extrapolated a number of priority BICs which could be investigated due to their spatial co-location with key European Atlantic Maritime clusters. Such co-location capitalises on the need for person-to-person contact and building of trust highlighted by Ellingsen et al., 2016a.

Action	Action Code	Action timeframe
Conduct an engagement exercise with ESA BIC leadership, BICs, ESA strategists and thematic cluster representatives to scope out the potential for BIC remits to be updated, along with the procedural needs and decision makers information needs, in order to assess the potential to do so.	E03A	Short
Scope the modifications to BIC remits, and resourcing modifications needed in order to expand BIC activities to support nationally-focused trans-sectoral innovation promotion, funding support information provision, NCP support, and National Space strategy derivation and implementation.	E03B	Short
Target and resource BICs to implement cross-sectoral innovation promotion supports.	E03C	Medium
Enhance National BICs capabilities and remit to inform and facilitate Industry-Academia-Society-Governance think-tanks on sourcing and driving trans-sectoral innovation and opportunity harnessing.	E03D	Long
Use BICs as showcase hubs for cross-sectoral technology transfer and innovation promotion.	E04	Short
Develop national BICs as detailed information hubs for what is available through ESA financial supports, in support of National Contact Points.	E05	Medium
Clarify available information on "What is an ESA BIC?" - reviewing and revising the overall ESA BIC, and individual BIC websites in terms of clarity and relevance of content in doing so.	E06	Short

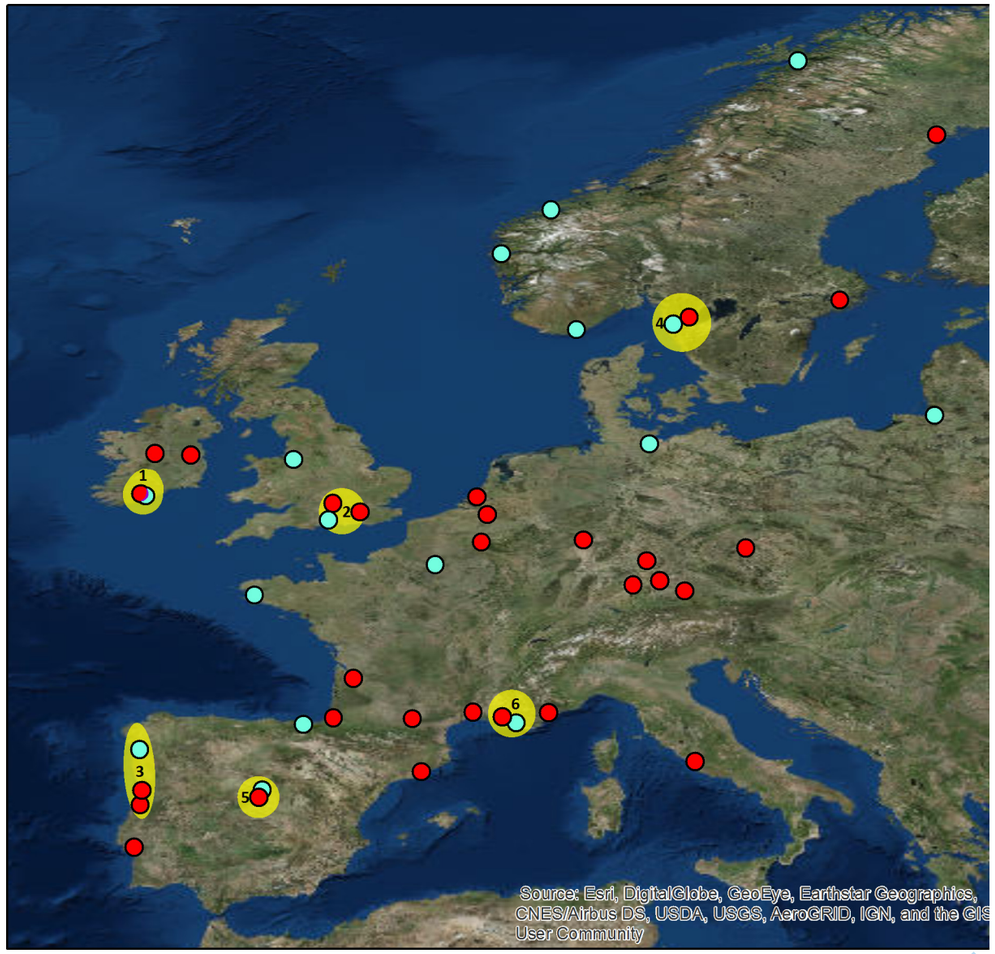


Figure 4: CINMarS-relevant Maritime Clusters (Blue), and ESA BIC regional office locations (Red) across Europe. Areas where BICs and Cluster lead offices are located relatively close to one another are indicated by yellowed areas. Regions of co-location are (1) Cork in Southern Ireland, (2) Southern England, (3) Coimbre in Portugal, (4) Goteborg region in Sweden, (5) Madrid in Spain, and (6) South-eastern France. (From Shanahan et al., 2016)

STRATEGIC FUNDING TO ANIMATE M-S INNOVATION AND KNOWLEDGE TRANSFER

The ESA programmatic funding calls enable the establishment of space sector capacity across Europe and within member states. However, it can also be used to animate solution derivation in key opportunity areas. The measures outlined here work closely with those outlined in the funding section of this roadmap. It is advisable that the ESA implement not only the applicable funding actions outlined in that section, but additionally implement the four actions described here, in close coordination with the funding actions.

Action	Action Code	Action timeframe
Design a maritime-focused funding call targeting space technology and capacity integration along the CINMarS identified priority areas, using CMEMS and H2020 EO Calls as basis documents for refinement.	E07A	Short
Implement and monitor the success/challenges faced by the funding mechanism and calls.	E07B	Medium
Devise calls for other priority thematic sectors (e.g. agriculture, disaster response, etc.).	E07C	Medium
Implement sectoral-focused mechanisms and calls on a priority driven basis.	E07D	Long

REDUCING BARRIERS TO SPACE TECH USE AND DEPLOYMENT

Three barriers where highlighted consistently throughout the CINMarS research activity. They are included as priority actions to be implemented in the short term here, but must be considered long-term in duration.

Action	Action Code	Action timeframe
Develop and provide sectorally-focused training/ capacity-building supports and activities to be deployed within target Clusters, which showcase existing services that exist in the sector of interest (here the maritime), identifies potential sectors for new technologies, and trains participants on the mechanisms used to develop these services, and how to access them, and utilises the experience of the ESERO in training and learning.	E08	Short
Make satellite communications cheaper for use in maritime telemedicine.	E09	Short
Continue measures, and explore more innovative ways, to improve the accessibility of space derived data (and the information it contains) for maritime and marine users. Very importantly, efforts should focus on reducing the cost where it is prohibitive.	E10	Short

PROMOTING AND COMMUNICATING STRATEGICALLY – GENERATING THE "PULL" FACTOR

As the hub of European knowledge on Space, the ESA has a significant capability to coordinate and drive the generation of a pull for space technology in other sectors. However, currently dissemination or "outreach" is less than optimal strategically, and in terms of its coherent implementation. Below are recommended actions which have been extrapolated from the CINMarS data. It is recognised that addressing the coordination of the outreach and education challenge is not a small task and as such short, medium and long term actions have been derived which address the issue systemically.

Action	Action Code	Action timeframe
Develop a road show targeted at key Maritime clusters to increase the awareness of the among the maritime sector of the opportunities available by engaging with the space sector, and incorporating space technologies.	E11A	Short
Develop a roadshow for deployment by clusters and networks in the wider maritime sector.	E11B	Medium
Expand deployment of roadshows via thematically-focused priority clusters and networks.	E11C	Long
Incentivise SMEs to develop information material on their space-derived solutions which can be disseminated at space solutions showcases, and attend if possible - examine EU and national funding mechanism rules ensuring that such promotion for the wider sector is funded through an appropriate mechanism and deemed a risk by an SME.	E12	Short
Improve communications with all maritime sectors initially using the maritime clusters identified in the CINMarS D1 report.	E13A	Short
Develop relationships with the maritime sector beyond the borders of Europe.	E13B	Medium
Engage with key maritime clusters to develop maritime focused showcase events.	E14A	Short
Engage with other thematically focused clusters to develop targeted showcase events, and subsequent roadshows.	E14B	Medium
ESA to scope and implement/support a series of sectoral days, beginning with a Maritime Day. Where possible, coordinate with the European Commission and other European initiatives, to harness the full potential of Europe-wide Maritime showcases. Scoping to involve consultation with maritime clusters.	E15A	Short
ESA to expand sectoral day events to other thematic priority areas (e.g. food security, disaster relief, governance supports etc.).	E15B	Medium
Monitor and review successes / challenges.	E15C	Long
Conduct a review of ESA project output availability, and devise a solution to make publically acceptable documents readily available. Ensure that the documents are not inaccessible through use of an overly complicated web interface.	E16	Short

HARNESSING THE "PULL" FACTOR EFFECTIVELY

Addressing outreach and education alone cannot address the engagement issue which restrains companies and innovators from exploiting Space-Maritime opportunities (or indeed opportunities between Space and other arena). Outreach and education generate a need for more information. If the delivery points for this additional information (and guidance to funding sources) is ineffective, the investment in outreach and education is limited in its return. The actions described below address this issue specifically building on the inputs of CINMarS consultees and CINMarS research targeting the Maritime-Space sector and animation of business using clusters. They should be considered as part of the ESA's wider efforts to address the communications challenge. Similar to outreach and education challenge, positioning effective structures to harness the reactive pull from outreach is no small task. As such short, medium and long term actions have been derived which address the thematic information issue iteratively, improving it over time.

Action	Action Code	Action timeframe
ESA to scope the development of a non-space (with appropriate language used) sectoral engagement information portal, to harness the reactive requests for information which results from non-space sectoral engagement and showcasing of ESA-funded success stories.	E17A	Short
ESA to implement the construction of the non-space sectoral engagement information portal. Apply the principals of Space Literacy being developed by the ESERO, use non space terminology, whilst highlighting the reliability of space tech, and concrete examples already developed in the context information.	E17B	Medium
Monitor and review successes / challenges.	E17D	Long

Space Sector - identifying and responding to trans-sectoral needs

As outlined above, the innovation and solution design, development and deployment is not done by the ESA, but is the product of the wider space sector – industry, SMEs, academia, educators and voluntary contributors. Efforts undertaken by the ESA must be supported and capitalised upon by the wider sector, embedding successes into the Maritime-Space sector.

Shaping National and international policy and strategy

Every person working in the Space sector encounters challenges every day. The ESA's activities in lobbying for National strategies to be developed which match National needs and priorities must be supported by a Space sector willing to participate and engage in the derivation of these strategies. This also applies at European level strategies. Furthermore, policy releases at National and European level must be examined and the opportunities for space sector involvement highlighted by the space sector itself, in support of the ESA's efforts.

Action	Action Code	Action timeframe
actively engage with the derivation of dynamic, short to long term, national and international strategies to coordinate efforts, promoting their need to seek opportunities in: - connecting with new markets and engaging with new sectors, - targeting the development of operational products and services that address the requirements of achieving the Sustainable Development Goals and the developing Green economy, with inherent sustainability perspectives, - enhance new entrepreneurs capabilities to generate revenue and strengthen the overall sector.	S01	Short
Lobbying and awareness raising of government departments should be encouraged by both the maritime and space sectors to include cross sector collaboration.	S02	Short
Take a proactive position to influence policies that will determine the way forward for Automated and Autonomous systems for the vessels of the future.	S03	Short
Members of the Space activities community and sector to seek and engage with representative industry bodies, government consultations etc., to raise the profile of space opportunities at the policy level.	S04	Short
Space sector groups in each country to compile position papers in response to past research prioritisation exercises at national and EU levels, and engage with ongoing and future research prioritisation exercises.	S05	Short
Space sector groups to promote their potential to address societal challenges where possible, ensuring engagement at all levels.	S06	Short
Examine GEOSS attempts to address societal challenges, and update and/or develop a more current/refined version of the GEOSS challenge objectives aligning with the Sustainable Development Goals.	S07	Short

TARGETING OPPORTUNITY AREAS FOR IN THE MARITIME-SPACE ARENA

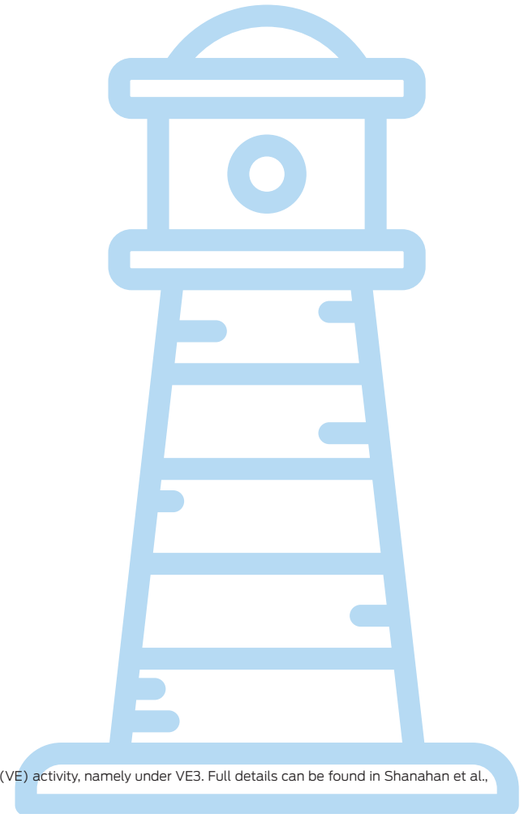
A number of priority target opportunity areas were identified by the CINMarS research activities. These require targeted short medium and long term actions to ensure that European companies position themselves, and deliver innovative solutions, to address these identified opportunity areas.

Action	Action Code	Action timeframe
Monitor developments in Pharmaceutical research, advances for the space sector may have benefits for the maritime sector.	S08	Short
Develop relationships with the maritime sector beyond the borders of the EU.	S09	Medium
Support trials placing 3D printers on board a sample of ships. Testing the communications links between the ship and its shore base support and transfer technical specs from the shore based support to the ships printer. Use the maritime clusters identified in D1 to promote the use of 3D printing throughout the Maritime sector.	S10	Medium
Take a leading role in the development of technology that will realise Autonomous vessels in the future.	S11A	Medium
Take an active role at the design stage for Automated-Autonomous vessels.	S11B	Long
Develop a system that allows the doctor ashore speak directly to the first aider on a vessel without relaying through a coastguard coastal radio station.	S12	Medium
Continue and increase engagement with designers and operators of aquaculture systems to gather their requirements to develop a marine toxin monitoring system, and address other issues (e.g. site identification, planning procedural difficulties, engineering challenges encountered by offshore opportunities) faced by the sector.	S13	Short
Develop and test a monitoring system that detects harmful toxins that would prevent safe harvesting of seafood.	S14	Medium
Develop sensors to be placed on vessel exhaust systems to detect NOx and SOx emissions.	S15A	Short
Develop a monitoring system that uses satellite communications to acquire up to date NOx and SOx emission levels from ships exhaust systems.	S15B	Medium
Engage with designers and operators in the MRE sector to discern their challenges, and needs. They should then scope the Space sector for potential solutions to address these needs, and overcome these challenges where possible.	S16	Short
Companies, where practical, to self-assess their approachability with regard to collaborative partnerships, and implement changes to their practices where barriers are identified.	S17	Short

PROMOTING OPPORTUNITIES FOR SPACE TECHNOLOGY TRANSFER AND APPLICATIONS

ESA's efforts at promoting, and coordinating the promotion of the Space sector, and its diverse range of associated technologies and companies, requires those companies and individuals to furnish the ESA with information on their achievements. It also requires the Space sector to engage with sectoral showcase and roadshow events to ensure that new markets and non-space sectors can see that Space is open for business, and demonstrate the full scope and scale of the Space sector, and the opportunities it presents.

Action	Action Code	Action timeframe
Actively promote and showcase the development and deployment of space-derived solutions which meet the needs of the maritime sector.	S18A	Short
Focus efforts on engaging with the non-space sector through non-space industrial conferences, Space fairs, business fairs and sectoral meetings.	S18B[6]	Short
Actively target maritime clusters and specific enterprises in areas such as shipyards, communications supplier, offshore companies, and the service sector (Insurance, banks, software vendors, certification bodies etc.) in efforts to showcase space solutions for the maritime sector.	S19	Short



[6]The application of Action S18B was explored further as part of the CINMarS Validation Exercise (VE) activity, namely under VE3. Full details can be found in Shanahan et al., 2016b.

FINANCING AND FUNDING – FUELLING M-S INNOVATION

In order to enable innovators to develop and ultimately harness commercially an innovation in the Maritime-Space arena, and indeed other trans-sectoral arenas, the provision of dependable and available funding is essential. The CINMarS investigation examined barriers and challenges being experienced by Clusters and companies in accessing these development supports and identified a number of structural and procedural issues which hamper the ability of companies based within clusters to carry their innovations forward. There was also a notable lack of awareness at the diversity and scale of funding available for companies to access, and the options available to innovators to apply for and secure development aid. Critically, both the unavailability of clear, concise and contextual information on, and clear understandable procedures to access, national and international funding sources, is hampering the uptake of development support in harnessing innovations.

ACTIVATING ENHANCED MARITIME-SPACE INNOVATION GROWTH

There are three core aims of the following targeted actions:

1. to enhance awareness of the available funding mechanisms in general, and facilitate Clusters and companies in obtaining the relevant information, and thus improving engagement with these funding support mechanisms,
2. to include a number of key principles which should be enshrined in calls targeting the animation of the Maritime-Space innovation arena,
3. to target funding at key points in the Maritime-Space sectors, their principal actors, and animate critical activities.

ENHANCING AWARENESS AND PARTICIPATION IN GENERAL

To access a funding source, one must first know it exists, and whether it is applicable to your interests. The provision of clear, concise and contextual information, in the language of the applicant is critical to ensuring enhanced awareness of, and engagement in, any future Maritime-Space funding support mechanism. A long term approach is recommended, with targeted short, medium, and long term actions. these incorporate iterative review and revision, and applicant consultation, as key principles to underpin enhancing awareness and participation, and developing funding mechanism engagement that are effective.

Action	Action Code	Action timeframe
Review funding application portals and contact points, ensuring the applicant perspective is taken, a streamlined application process is devised, and stakeholders with experience of current schemes form a part of the iterative review and design process.	F01A	Short
Devise and implement corrective measures	F01B	Medium
Monitor and review successes / challenges	F01C	Long
Conduct dialogue activities to scope the potential for funding participation rule simplification	F02A	Short
Implement corrective modifications in targeted funding mechanisms	F02B	Medium
Implement funding programmes with medium term (3-10 year) durations, to foster stability, surety and transparency in target sectors	F03	Medium
Build upon the outputs of the Colombus project ensuring that project outputs marked public, produced from EU and national funding mechanisms are made easily available and readily accessible. Ensure that the documents are not inaccessible through use of an overly complicated web interface.	F04	Short

GUIDELINES FOR FUTURE CALLS

The inclusion of terms, and directions in call documents can vastly reshape the solutions proposed in response. The CINMarS literature review and consultation extrapolated key phrases and objectives which should be included in any call seeking to animate the Maritime-Space innovation arena, and in many cases other trans-sectoral innovation arenas.

Action	Action Code	Action timeframe
Ensure that future calls highlight the need for multi-disciplinary and trans-sectoral approaches to be sought	F05	Short
Ensure that future calls target specifically the need for innovation, networking and network building, technological improvement	F06	Short
Ensure that future calls target specifically the need for strategy development, and the support of such development	F07	Short
Ensure that future calls target specifically the need to build links between established and start-up enterprises.	F08	Short
Ensure funding calls which are targeting trans-sectoral innovative solutions specifically seek to link multi-disciplinary, multi-national solutions to regional or national priority needs.	F09	Short

TARGETED FUNDING TO UNLOCK M-S POTENTIAL

The following suggested actions target funding towards key problem areas which can hamper innovation development in the Maritime-Space arena (amongst others). The actions recognise that simply funding problem areas is not an effective solution, proposing intelligent targeted funding as an alternative, with defined short medium and long term actions to enable deriving credible funding mechanisms, setting viable funding goals, and seeking the best-practice lessons to be applied elsewhere into other trans-sectoral animation initiatives.

Action		Action Code	Action timeframe
Target funding at start-ups for acceleration	Devise a set of fast track start-up funding source, targeting the Maritime-Space innovation sector	F10A[7]	Short
	Implement these funding sources which fast track start-up funding source, targeting the Maritime-Space innovation sector	F10B[8]	Medium
Build administrative capacity to respond to calls	Implement a funding call specifically to extrapolate the challenges faced by Human Resource departments in supporting innovation, and HR structures and processes which when in place, support trans-sectoral, collaborative and trans-national innovation harnessing	F11A	Short
	Implement the recommendations arising from projects completed through the HR-examination call (implemented through F11A).	F11B	Medium
	Scope the practicalities of developing a mechanism for Overheads to be channelled into developing core HR capacity to support M-S innovation initiatives which enable more long-lasting job security, the development of long-term core capacity in key priority research fields, and develop lasting bridges between Sea and Space.	F12A	Short
	Design and implement the new funding call / modifications identified in action F12A to existing funding calls, reviewing successes and issues faced.	F12B	Medium
	Refine the calls developed through action F12A and F12B, and transfer procedures and best practices to other inter-sectoral priority areas.	F12C	Long
	Ensure funding calls recognise the importance of funding the underpinning Human Resources which enable innovators, researchers and commercial developers to focus on innovation and commercialisation.	F13A	Short
	Build upon progress from F13A and Implement specific medium-term HR-focused funding calls (with a long term embedding goal) to enable long-term innovation support	F13B	Medium
Build TTO and BIs into Clusters	Extrapolate and design the funding structures required for BIs and TTOs to integrate effectively into Clusters and Networks	F14A	Short
	Target funding (designed through F14A) towards BIs and TTOs to enable them to develop Cluster/network-focused support hubs.	F14B	Medium
De-risk SME engagement in sectoral promotion activities	Incentive SMEs to develop information material on their space-derived solutions which can be disseminated at space solutions showcases, and attend if possible - examine ESA funding mechanism rules ensuring that such promotion for the wider sector is funded through an appropriate mechanism and deemed a risk by an SME.	F15	Short

[7]The application of Action F10A was explored further as part of the CINMarS Validation Exercise (VE) activity, namely under VE2. Full details can be found in Shanahan et al., 2016b.
[8]The application of Action F10B was explored further as part of the CINMarS Validation Exercise (VE) activity, namely under VE2. Full details can be found in Shanahan et al., 2016b.

BUILDING AN ENHANCED SME FOCUS FOR DIVERSITY AND FLEXIBILITY

Small and medium size enterprises (SMEs) are the backbone of Europe's economy. They represent 99% of all businesses in the European Union[9], and are considered by the European Commission as being key to ensuring economic growth, innovation, job creation, and social integration in the EU. Their small size, sheer number, and diversity of interests can add a significant level of flexibility and adaptability to a Cluster's capability to respond to and rapidly capitalise on new innovation areas, such as emerging opportunities in Maritime and Space. However, empirical studies have shown that the propensity to engage in knowledge-based networks decreases with decreasing firm size. This is a reflection of the fact that the capacity for pursuing innovation by many SMEs is limited, with SMEs focusing on their core business and less risky avenues for revenue (Shibany & Polt, 2001). Given their small size and critical focus on funding, it is perhaps here where targeted efforts to engage SMEs, and de-risk activities associated with innovation, can have an impact.

Understanding the SME experience, and enhancing participation

"SME's are a little too fiddly!"
(CINMarS Consultee)

SMEs, even more than larger firms, depend on external sources of information in order to build their own innovative capability, and to reach their target markets. Although SME have different needs, all must be connected to the most prolific sources of new knowledge and expertise, either directly or through multi-layered networks (Ferreira et al., 2016). Their sheer numbers and diversity in goals and organise making it challenging for a one-size-fits-all model of funding to be applied. What is evident is that funding mechanisms, though intended to build SME involvement in developing trans-sectoral solutions, often do not gain as much traction as envisioned. This is understandable given the likelihood of funding mechanism designers to have an SME background, which can be mitigated against by engaging fully and iteratively with SMEs during the call design, and implementation process. The actions suggested below reflect this. They adopt a short-medium-long term view, understanding that the complexities of engaging with and targeting supports effectively at such a diverse and changeable industry component is not fully achievable in the short-term, but requires long term investment and iterative re-assessment.

Action	Action Code	Action timeframe
Review the front ends of funding portals, processes, and procedures (using a stakeholder-driven approach) to determine best practice modifications needed to animate Cluster-participant and SME involvement.	F16A	Short
Implement recommended modifications to funding portals, processes, and procedures	F16B	Medium
Monitor and review SME and Cluster Participant involvement and successes / challenges of the modifications	F16C	Long
Review funding mechanism reporting and auditing needs and procedures, ensuring that wherever possible the need for control and auditing is balanced with the need for accessibility and flexibility.	F17A	Short
Devise and Implement corrective measures where necessary	F17B	Medium
Monitor and review successes / challenges	F17C	Long
Examine currently engaged companies in mechanisms which envision supporting both SME's and larger companies, exploring whether there is adequate flexibility in application, financing, and monitoring procedures and processes, to align with the operational needs and challenges faced by both, and identify the modifications needed in current and future programmes	F18A	Short

[9]SMEs are defined in the EU recommendation 2003/361 and is based on number of employees and either turnover or balance sheet total. Medium-sized: employees < 250, turnover ≤ € 50m or balance sheet total ≤ € 43 m, Small: employees <50, turnover ≤ € 10 m or balance sheet total ≤ € 10 m, Micro: employees < 10, turnover ≤ € 2 m, or balance sheet total ≤ € 2 m.

Devise and implement appropriate corrective measures where the need is identified	F18B	Medium
Monitor and review successes / challenges	F18C	Long
Scope the realities of SME experiences with applying for and working with current mechanisms, and identify challenges caused by inflexibility and over-complications.	F19	Short
Devise and develop a recognised competitive, auditable, yet low risk (phased application), European-level funding mechanism to take prototype products and develop them into a commercial product. SMEs and startups should be consulted iteratively during the development of this mechanism.	F20A	Short
Review funding application processes and funding draw down and monitoring procedures for mechanisms which envision SME involvement, ensuring that the procedures, processes and frameworks account for the realities of SME operations.	F20B	Short
Devise and implement appropriate corrective measures where the need is identified	F20C	Medium
Monitor and review successes / challenges	F20D	Long
Review current funding mechanisms, and target organisation engagement. Where SME participation is desired scope the potential to implement a phased application approach to allow for SME's to quickly bid for idea development, and avoid the risk of bidding for complete applications which could be rejected.	F21A	Short
Implement funding application design changes where necessary	F21B	Medium
Monitor and review SME involvement and successes / challenges	F21C	Long
Develop decision tree-based funding guides, to help SMEs (and advisory NCPs) identify and guide innovators to funding mechanisms that could be accessed to take a good idea forward.	F22	Short
Frame the language of Support mechanisms calls, and their focus, to allow actors from outside the space and maritime sectors to get involved and innovate with the space and maritime sectors	F23	Short

GEOGRAPHICAL EXPANSION OF MEASURES

The Clusters involved in this project, such as Fórum Oceano, IMERC, and Marine Southeast (MSE) interacted with the activities developed and knowledge gained during CINMarS, this participation, their target markets, and embedded technologies and knowledge capabilities means they are in a good position to:

- develop integration of space related activities, namely in renewable energy, aquaculture and deep sea exploration challenges,
- implement the actions at the Cluster level to prepare and enhance the cluster's capability to drive companies in harnessing Maritime-Space opportunities,
- lobby for the integration of policy, and funding actions with relevant actors.

From these initial clusters, action implementation at national levels should expand. In the case of Norway, the most suitable clusters would be the three Global Centres of Expertise (GCE): Blue Maritime, GCE Subsea, GCE Node, and Maritime Forum Norway (MFN). GCE clusters have close collaboration and partnership with the universities, R&D institutions and other knowledge and educational infrastructure in their region and are in a good position for joint innovation in their areas of expertise. Meanwhile MFN plays an important policy role in the Maritime arena centred on Norway, functioning as a National Maritime cluster.

The strength of Pole Mer Bretagne Atlantique network, scope of maritime activities, public support (regional and national) and its close involvement in developing innovation in its own territory, put this cluster in a good position to develop integration of space related activities, namely in: aquaculture; renewable energy; deep sea mining; environmental protection and monitoring; safety and security; shipping; and, logistics. Moreover, Pole Mer Bretagne Atlantique co-ordinate the recently funded national-level MORESPACE project that aims to accelerate the use of satellite data in the maritime sector. Therefore, this cluster is already active in taking advantage of Space activities that are maritime relevant.

The European Network of Maritime Clusters (ENMC) although at present is focused largely on the traditional sectors of shipping and shipbuilding, and in lobbying activities, can also be a communication channel to spread the opportunities identified in this project for joint collaboration and innovation between the identified priority space and maritime activities. Fórum Oceano and IMERC are part of this network and could facilitate this information for the other partners.

National clusters such as Cluster Maritime Français, UK Maritime and Cluster Marítimo Español, which gathers national and regional members, can also act as a platform to spread this information at national level. However, it must be noted that these are not as knowledge- or research-driven as other maritime clusters mentioned above and require significantly more effort to prepare themselves to implement the recommended actions.

Concerning other geographies beside the Atlantic, if a similar exercise is envisaged for the Mediterranean the Pole Mer Mediterrannée the "twin" brother of Pole Mer Bretagne Atlantique would be in a good position for develop integration of space related activities.

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ANNEX A – ACTION TRACEABILITY TABLE

See the original Technical report (DOI DOI: 10.13140/RG.2.2.27298.73927) containing the full action derivation table. This shows the origins of all derived actions, and the iterative stakeholder-led modifications which led to their finalisation.

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