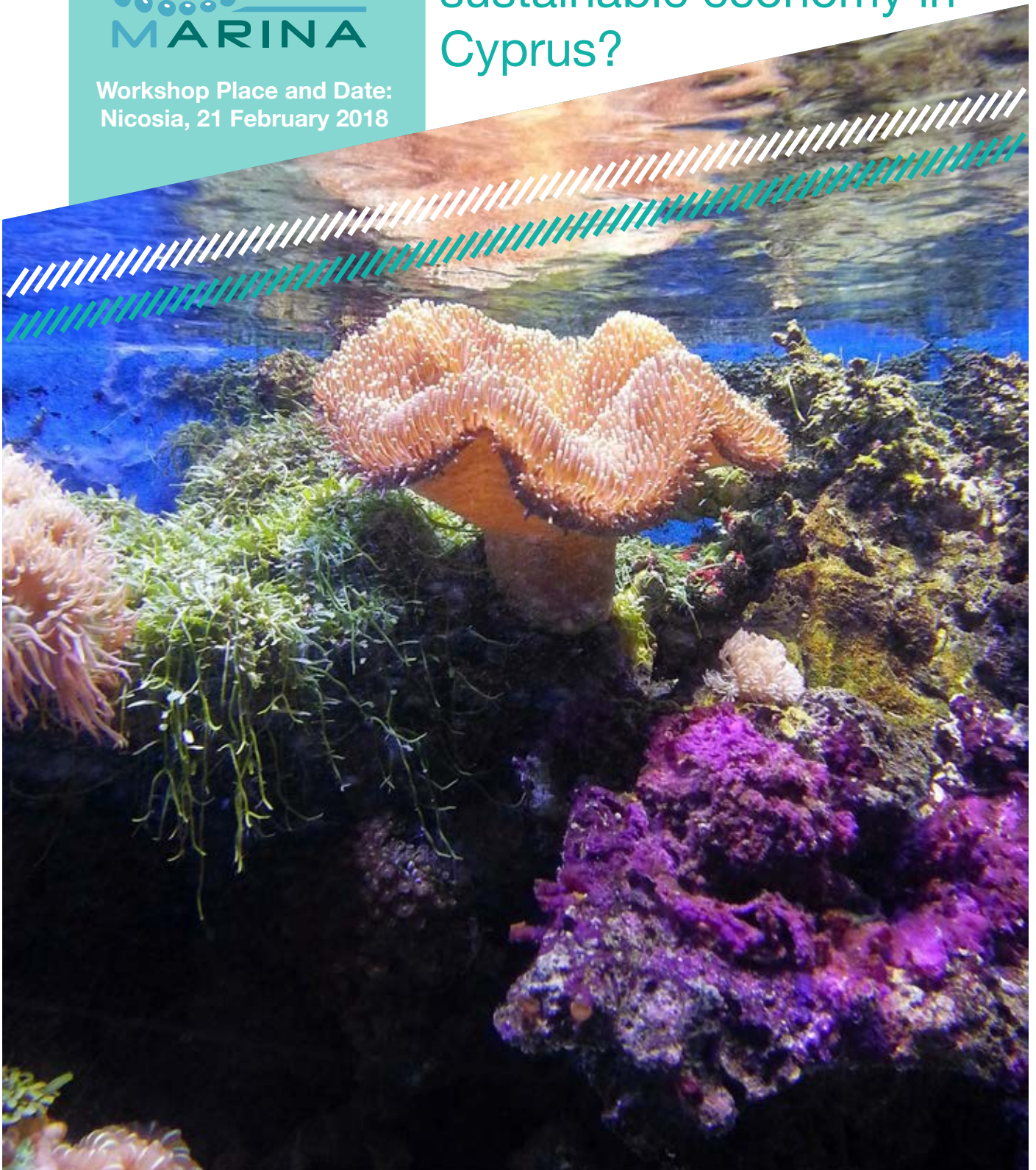




Workshop Place and Date:
Nicosia, 21 February 2018

How may we develop the Marine Biotechnology as a source of local and sustainable economy in Cyprus?



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“How may we develop the Marine Biotechnology as a source of local and sustainable economy in Cyprus?”

Workshop Place and Date: Nicosia, 21 February 2018

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The purpose of this report is to present the results of the local Mobilisation and Mutual Learning (MML) workshop “How may we develop the Marine Biotechnology as a source of local and sustainable economy in Cyprus?” that was jointly organised by XPRO Consulting Limited (XPRO) and the Cyprus Neuroscience & Technology Institute (CNTI) and hosted by the Water Board of Nicosia, in Nicosia Cyprus on 21st February 2018. The workshop, which is realised in the context of the European Union’s Horizon 2020 funded project MARINA, focused on how Cyprus could develop the field of marine biotechnology through Responsible Research and Innovation (RRI) actions.

The report provides a comprehensive account of the discussion, results and action-map generated by the participants. The workshop utilised the participatory approach of Structured Democratic Dialogue. Furthermore, the report includes a general outline and international background of the MARINA pan-European MML process of stakeholder engagement in marine and maritime issues and Responsible Research and Innovation.

The results of the workshop will provide input for the road-map of Responsible Research and Innovation good practice as well as recommendations about embedding the RRI in the policy-making processes. They will be assembled with the outputs of other local MARINA MML workshops organized across Europe in a comprehensive report that will be submitted to the Directorate-General for Research and Innovation of the European Commission. Furthermore, the results of the workshop will be used for extracting lessons learned and identifying best practices for the MARINA RRI Road map.

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Executive Summary

The local Mobilisation and Mutual Learning (MML) workshop “How may we develop the Marine Biotechnology as a source of local and sustainable economy in Cyprus?” was organised by the MARINA partners XPRO Consulting Limited and CNTI. The workshop was held on 21st February 2018 at the Water Board of Nicosia conference room in Nicosia, Cyprus.

The local title of the workshop that was held in Greek-Cypriot is:

«Πώς θα μπορούσαμε να αναπτύξουμε την Θαλάσσια Βιοτεχνολογία ως πηγή τοπικής και βιώσιμης οικονομίας στην Κύπρο;»

The participants of the workshop discussed the development of the marine biotechnology in Cyprus in the perspective of Responsible Research and Innovation. The triggering question to address this issue was «What Responsible Research and Innovation actions are needed to make marine biotechnology a sustainable source of local economy in Cyprus?» In response to it, they put forth proposals of participatory RRI-driven actions.

The main conclusions of the workshop were the following:

- The marine biotechnology sector is a complex multidisciplinary field that needs cooperation between public and private societal actors;
- A national strategy and a legal framework are required focusing on enabling businesses through financial and tax incentives to invest in the field of marine biotechnologies;
- A national research centre in marine biotechnology and educational programmes at university level is required;
- Creation of funding mechanisms for marine biotechnology through private public partnerships is needed;
- Marine literacy and awareness must be included in school programmes and extended to the wider public through a natural history museum;
- Citizens should participate in decision-making and in monitoring the marine and coastal environmental status;

Responsible Research and Innovation (RRI) implies a transparent and interactive process where societal actors and innovators actively collaborate to co-create solutions, services and products that are socially acceptable, sustainable and resolve important societal issues. RRI focuses on how to make research and innovation more useful to the society and how to protect the environment at the same time. Regarding how Responsible Research and Innovation (RRI) and its dimensions may enable marine biotechnology research and innovation actions, the actions focused on the following dimensions:

Open access was the most common dimension that appeared in 24 actions, to be followed closely by Science Education (22 actions). Governance (16 actions) and Public Engagement (15 actions) follow. Ethics relates to 5 actions and Gender Equality to 2 actions.

The MML workshop aimed, in particular, to enable the process for defining a common vision and an action plan for a Cypriot Marine Biotechnology strategy that will enable scientists, policy-makers, investors, SMEs and the public to address the challenges of this new marine sector and to make them aware for the need to define a national strategy for this non-existent for the island sector. Thus, the goal of this workshop was to discuss the subject of Marine Biotechnology (MB) and to define an action plan as to enable MB in Cyprus through Responsible Research and Innovation (RRI) actions.

The event was held in the framework of the MARINA project and was part of the Mobilisation

and Mutual Learning process composed of two levels of workshops; at local and international levels. The workshops have been engaging European civil society, business, research and policy-makers in a participatory debate to examine how Responsible Research and Innovation can help to overcome the current marine societal challenges and unlock the potential for Blue Growth in marine and coastal areas of the European Union.

During the workshop the participants presented 38 ideas of Responsible Research and Innovation actions and developed a roadmap of how Cyprus may develop a marine biotechnology strategy through RRI. Furthermore, the participants related the actions to the RRI dimensions in priority order.

The workshop was video-recorded by CNTI. The video was not broadcasted but instead it is stored in the CNTI archives and explanations of the actions can be found [here](#).



Engaging societal actors in Responsible Research and Innovation for smart sustainable and inclusive Blue Growth in Europe

Mobilisation and Mutual Learning Workshops

The local workshop “How may we develop the Marine Biotechnology as a source of local and sustainable economy in Cyprus?” was held in the framework of the MARINA project. It was organised by XPRO Consulting Limited (XPRO) and Cyprus Neuroscience and Technology Institute (CNTI) in Nicosia, Cyprus on 21/2/2018. The workshop has been part of the second round of the Mobilisation and Mutual Learning Process composed of two phases of workshops at local and international levels and connected to the international Responsible Research and Innovation practitioner and policy-maker event. The process can be illustrated as follows:



Figure 1: MARINA Mobilisation and Mutual Learning Process

The workshop:

- Engaged Cypriot societal actors in a multi-actor dialogue and in co-creating a participatory roadmap of actions for tackling the marine societal challenge of marine biotechnology and based on Responsible and Innovation principles;
- Started the process of federating Civil Society Organisations (CSOs), citizens, businesses, industry, research, policy-makers and communicators face-to-face and on-line;
- Set in motion inclusive mechanisms for sharing knowledge and best practice, building common understanding and co-creating solutions to marine societal challenges and based them on the principles of Responsible Research and Innovation;
- Facilitated federation of communities and networks on the MARINA digital platform.

How can Responsible Research and Innovation ensure a smart, sustainable and inclusive Blue Growth in Europe?

Europe is facing “innovation emergency”: it spends 0.8% of GDP less than the USA and 1.5% less than Japan on Research & Development (R&D) every year. Thousands of European best researchers and innovators have moved to countries where conditions are more favourable¹, despite the support by the European Union to foster research and innovation in terms of networking, funding², social business, start-up, dissemination and incubation³.

Therefore, in 2018, the European Commission will increase the support of smart and inclusive growth with €76.5 billion in commitments and €66.4 billion in payments, i.e. up by 2.1% and 17.5% respectively compared to 2017. Seas and oceans are drivers of the European economy and have great potential for innovation and growth. They can contribute to achieving the goals of the Europe 2020 strategy for smart, sustainable and inclusive growth. Accordingly, the European Union has set out the Blue Growth⁴ long-term strategy to support sustainable development in the marine and maritime sectors in Europe. This strategy aims to boost growth in areas such as aquaculture, coastal tourism, marine biotechnology, ocean energy and seabed mining. It puts forward three

¹<http://ec.europa.eu/research/innovation-union>

²Employment and Social Innovation Programme, Horizon 2020, SME Instrument, Collective Awareness Platforms, EU structural and investment funds - Guide to Social Innovation. Social Challenges Platform.

³https://ec.europa.eu/growth/industry/innovation/policy/social_it

⁴https://ec.europa.eu/maritimeaffairs/policy/blue_growth_en

priorities to make Europe a smarter, more sustainable and more inclusive place to live:

- Smart growth, through the development of an economy based on knowledge, research and innovation;
- Sustainable growth, through the promotion of resource-efficient, green and competitive markets;
- Inclusive growth, through policies aimed at fostering job creation and poverty reduction⁵.

At a global level, in the 2030 Agenda for Sustainable Development, social challenges are a priority for a sustainable growth⁶.

[Responsible Research and Innovation](#) is a key cross-cutting instrument to reach these goals, an investment for our future. In practice, it is implemented as a package that includes multi-actor and public engagement in research and innovation, thanks to open access to scientific results, formal and informal science education and the take up of gender and ethics in the research and innovation content and process.

Responsible Research and Innovation (RRI) is a transparent, interactive process by which societal actors and innovators become mutually responsive to each other with a view on the (ethical) acceptability, sustainability and societal desirability of the innovation process and its marketable products (Von Schomberg, 2011).

The European Commission distinguishes 6 key dimensions of RRI: Public Engagement, Science Education, Open Access, Gender Equality, Governance and Ethics⁷.

Public and multi-stakeholder engagement is a societal commitment to provide encouragement, opportunities and competencies that will empower citizens and civil society organisations to participate in research and innovation for co-defining and co-designing solutions addressing societal issues. It is also about bringing together a diversity of actors from research community, policy-making, business and industry, which would not normally interact with each other, on matters of science and technology⁸.

Science Education aims at increasing society’s appetite for innovation and interest in science, in particular among young people with a special emphasis on girls. It encourages innovative pedagogies to teach science, the involvement of institutions that organize such activities, promotes RRI in higher education curricula and eases access to scientific careers⁹.

Open access and open science intend to make research findings, data, scientific publications and information available free of charge for anyone.

Gender Equality aims at removing barriers that generate discrimination against women in scientific careers and decision-making. It fosters gender balance in research teams and integrates a gender dimension in research and innovation content in order to improve the scientific quality and societal relevance of the produced knowledge, technology and innovation¹⁰.

Ethics is given the highest priority in the European Union funded research and innovation. It implies the application of fundamental ethical principles and legislation to scientific research and innovation

⁵http://ec.europa.eu/eurostat/statistics-explained/index.php/Smarter,_greener,_more_inclusive_-_indicators_to_support_the_Europe_2020_strategy

⁶Sustained, inclusive and sustainable economic growth is essential for prosperity. [...] We will work to build dynamic, sustainable, innovative and people-centred economies, promoting youth employment and women’s economic empowerment, in particular, and decent work for all.”

⁷<https://ec.europa.eu/programmes/horizon2020/en/h2020-section/responsible-research-innovation>

⁸<https://ec.europa.eu/programmes/horizon2020/node/766>

⁹<https://ec.europa.eu/programmes/horizon2020/node/795>

¹⁰<https://ec.europa.eu/programmes/horizon2020/node/797>

in all possible domains and includes the avoidance of any breach of research integrity and ethics dumping¹¹.

Governance is the umbrella for all other dimensions. It addresses the responsibility of policy makers to prevent harmful or unethical developments in research and innovation and developing harmonious models for Responsible Research and Innovation that integrate Public and multi-stakeholder Engagement, Science Education, Open Access, Gender Equality and Ethics¹².

The Blue Growth strategy reflects policy priorities. It aims at bringing together resources and knowledge across different fields, technologies and disciplines, including social sciences and the humanities by addressing the following challenges:

- Health, demographic change and well-being;
- Food security, sustainable agriculture and forestry, marine and maritime and inland water research, and the Bioeconomy;
- Secure, clean and efficient energy;
- Smart, green and integrated transport;
- Climate action, environment, resource efficiency and raw materials;
- Europe in a changing world - inclusive, innovative and reflective societies;
- Secure societies - protecting freedom and security of Europe and its citizens.

The MARINA workshops and Sustainable Development Goals

The European Union's response to the 2030 agenda of the United Nations Organisation is "The new European consensus on development of 'our world, our dignity, our future'". The document highlights that "the EU and its Member States will integrate the respect of human rights, democracy, the rule of law and gender equality into their political dialogue" and that "sustainable development requires a holistic and cross-sector policy approach and is ultimately an issue of governance which needs to be pursued in partnership with all stakeholders and on all levels"¹³. Accordingly, the topics mostly addressed at this particular MARINA workshop and related to Sustainable Development Goals¹⁴ are highlighted in bold:

- SD Goal 1: End poverty in all its forms everywhere;
- **SD Goal 3: Good Health and Well Being;**
- **SD Goal 4: Quality Education: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all;**
- **SDG 5: Gender Equality**
- SD Goal 6: Ensure availability and sustainable management of water and sanitation for all;
- **SD Goal 7: Affordable and clean energy: Ensure access to affordable, reliable, sustainable and modern energy for all;**
- **SD Goal 8: Decent Work and Economic Growth: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all;**
- **SD Goal 9: Industry, Innovation and Infrastructure: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation;**
- SD Goal 11: Make cities and human settlements safe, resilient and sustainable;
- SD Goal 12: Ensure sustainable consumption and production patterns;
- SD Goal 13: Take urgent action to combat climate change and its impacts;
- **SD Goal 14: Life below Water: Conserve and sustainably use the oceans, seas and marine resources;**
- SD Goal 17: Strengthen means of implementation and revitalise the global partnership for sustainable development.

And more specifically MB relates as follows:

- SDG14: Life Below Water: Through MB we will have a better understanding of the marine wealth and it will push us to care and conserve our ocean and seas.
- SDG3: Good Health and Well Being: Through MB new medicinal solutions will be discovered as for example in antibiotics and oncology. Moreover, MB enables ocean literate societies by explaining how different marine organisms function and how they enable pharmaceutical and well-being discoveries and developments.
- SDG 8: Decent Work and Economic Growth: MB is a growing sector enabling countries to secure jobs and economic growth.
- SDG 9: Industry, Innovation and Infrastructure: MB is a highly innovative sector and it will enable new types of companies to form and flourish.
- SDG 4: Quality Education: MB is a vast field, which requires multidisciplinary education and life-long learning.
- SDG 7: Affordable and clean energy: By knowing more about the marine organisms and their functions, we can ensure better sources of energy.
- SDG 5: Gender Equality: Due to its multi-disciplinarity, MB can empower women to contribute to its development through research and entrepreneurial activities.

¹¹<https://ec.europa.eu/programmes/horizon2020/node/767>

¹²https://ec.europa.eu/research/swafs/pdf/pub_public_engagement/responsible-research-and-innovation-leaflet_en.pdf

¹³https://ec.europa.eu/europeaid/sites/devco/files/european-consensus-on-development-final-20170626_en.pdf

¹⁴<https://sustainabledevelopment.un.org/>

The choice of the workshop marine topic

The marine challenges and the topics of the workshops in the second round stemmed from international and national agendas. They have been: marine biotechnologies, sea transportation, deep-sea mining, renewable energy (wind, wave and tidal) and marine changes caused by climate.

The participants of the workshop “How may we develop the Marine Biotechnology as a source of local and sustainable economy in Cyprus?” in Nicosia, Cyprus discussed the marine challenge of marine biotechnology in the perspective of Responsible Research and Innovation. The triggering question to address this issue was “What Responsible Research and Innovation actions are needed to make marine biotechnology a sustainable source of local economy in Cyprus?” In response to it, they put forth proposals of participatory RRI-driven actions.

Responsible Research and Innovation (RRI) implies a transparent and interactive process where societal actors and innovators actively collaborate to co-create solutions, services and products that are socially acceptable, sustainable and resolve important societal issues. RRI focuses on how to make research and innovation more useful to the society and how to protect the environment at the same time.

The RRI Core Subjects are:

- Reflection on ethical and social impacts
- Aligning R&I with users and societal needs
- Engaging stakeholders in the R&I process
- Equality and transparency in information and communication, education and ethics

The application of the RRI in Marine Biotechnology (MB) will help solve important societal problems such as health (e.g. pharmaceuticals from MB), food security (e.g. improved aquaculture through MB), and sustainable ocean management (e.g. protecting our marine environment). This can be done by highlighting the societal problems and trying to provide solutions in a collective and responsible manner.

RRI fits very well the field of MB, since MB is aiming at finding new compounds for medical, pharmaceutical and food applications and thus addressing societal issues such as food security, health and well-being, healthy ocean and environment. MB is by nature an interdisciplinary field requiring close collaboration among scientists, industry and other stakeholders such as venture capitalists. RRI has several dimensions: public engagement, science education, open science, gender balance, ethics and governance; all very relevant for the Cypriot scientific society in the following manner:



Public Engagement:

Any product development is risky and costly. No one wants to develop a product that society is not interested to buy and use. Through public engagement, citizens, who are the consumers, can co-design and provide their views, so that the product is relevant to the society's needs. Public engagement would be beneficial for Cyprus MB, since the Cypriot public is already positive for this type of blue growth.



Open Access:

Openness and sharing knowledge may lead to new ways of inspiration, innovation and profit. Consumers become interested as they favour transparency and it can be a better way for testing product development and accepting the product once it is on the market. Policies and business practices must be focusing on open access for faster developing the MB sector but in a responsible collaborative manner.



Science education:

MB is a field of tomorrow and educating the people, who will fulfil them today, creates the jobs of tomorrow. It is thus important that the high schools and university curricula are adjusted to meet the needs of MB. In the Cyprus national MB strategy, science education needs to be included to ensure its continuous successful execution.



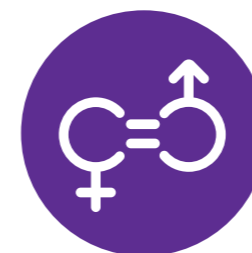
Ethics:

MB like any high technological and scientific field is governed by science ethics. The same applies for company practices. How can MB developments be ethical towards the marine organisms used and towards the consumers that will use these products? How may MB products be tested so that they improve human living standards and do not destroy the sea ecosystems? How should MB products be labelled, so that the consumer knows about it? MB is not about quick profits and companies should focus beyond this as they have a societal responsibility to follow protocols and conventions on ethical aspects.



Governance:

Government must define common laws and policies and apply them without exception. Companies need to implement these policies and norms for aligning their interests with the needs of society. Governance is relevant for the basic research agenda setting, for the extraction of marine resources (where, how, for what, ownership). Environmental sustainability is pivotal for MB and policies and laws must also.



Gender Equality:

MB will further enable gender equality since it is a new field for Cyprus and it can provide a new and equal start for all actors (male and female) in the research and innovation processes.

How may we develop the Marine Biotechnology as a source of local and sustainable economy in Cyprus?

The current situation

Almost on all Cypriot beaches after a storm, we see piles and piles of “fikia”/“fitsia” the generic Greek-Cypriot word for seaweeds. *Posidonia Oceanica* is the most common seaweed type, which is easily recognizable on the beach as thick grey layers made out of its dead leaves. Studies have shown that *Posidonia Oceanica* has antidiabetic, antioxidant and vasoprotective properties, which means that it can be exploited to develop among others products in the field of medicine to cure diseases. This can be facilitated and achieved through a recently developed specialized sector named Marine Biotechnology (MB) which could be defined as “the use of marine bioresources as the target or source of biotechnological applications”¹⁵ (OECD) where Biotechnology refers to “the application of science and technology to living organisms, including parts, products and models, to alter living or non-living materials for the production of knowledge, goods and services”¹⁶ (United Nations 1992).

Marine Biotechnology (MB) is defined as “The application of science and technology to living organisms, as well as parts, products and models thereof, to alter living or non-living materials for the production of knowledge, goods and services” (OECD, 2005). MB is an innovative field of research in science and technology using marine living organisms for innovative products and tools. By better understanding the qualities of marine species, we can produce new food, drugs, and energy to overcome global demand and solve several important societal challenges. The exploitation of biotechnology for new drugs, including enzymes, antibiotics and chemical compounds from marine sources are goals that Europe is focusing on as part of its Blue Growth Strategy.

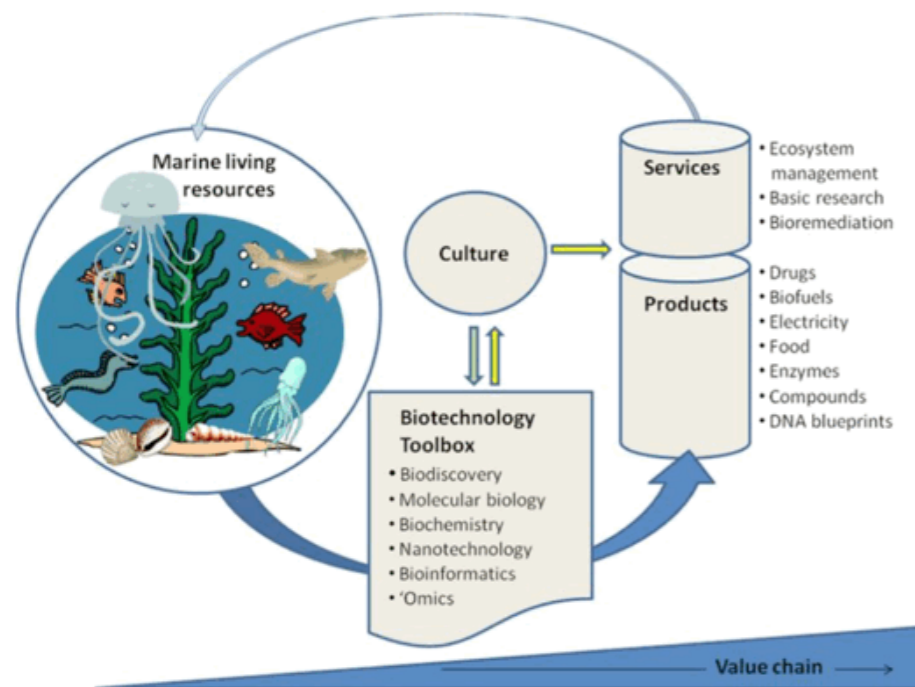


Figure 2: Blue Growth through Marine Biotechnology¹⁷

The potential of Marine Biotechnology to contribute towards the development of sustainable economy, the production of new medicines, including enzymes, antibiotics and chemical compounds from marine sources, and the overcome of global challenges (e.g. climate change) has already been identified at a European level and for this reason, MB has been situated within the umbrella

of Blue Growth Strategy .

On a national perspective, the majority of EU countries have proceeded with defining a national marine biotechnology strategy, which is considered the cornerstone for a successful and sustainable development of the sector. Particularly, the leading regions in MB are the member states of the Atlantic (Ireland, UK, France, Spain and Portugal) and Northern Europe, such as the Baltic countries, Denmark and Sweden. According to the Marine Biotechnology ERA-NET, a consortium of 19 national funding agencies in the area of Marine Biotechnology, Cyprus has yet to define a national Marine Biotechnology Strategy¹⁸, whereas all other Mediterranean member states do. Therefore, it is a necessity for Cyprus to develop its national marine biotechnology strategy and focus on how to create wealth and protect at the same its marine environment.

Investigating the financial benefit from the development of this sector, it is estimated that the current revenue generation across Europe reaches the amount of €754 million and is expected to grow by 6-8% per year. It is further estimated that the number of working positions for researchers and practitioners in the field of MB could evidently reach 10,000 more jobs in 5 years. The predominant players in the European MB are micro SMEs that need support in terms of financial access and policies to facilitate their research and innovation activities. It should be noted though that the number of SMEs currently operating in this field in Europe is frankly low, as it does not exceed 150 in total. The situation in Cyprus is even more disconcerting considering that, despite being an island; only one micro SME is currently involved in the area of MB working particularly with algae.

¹⁵<https://www.oecd.org/sti/biotech/49558746.pdf>

¹⁶<https://www.cbd.int/doc/legal/cbd-en.pdf>

¹⁷http://ec.europa.eu/eu2020/index_en.htm

¹⁸http://www.marinebiotech.eu/wiki/Marine_Biotechnology_in_European_countries

MML Workshop Methodology Used: Structured Democratic Dialogue

The workshop was executed and facilitated based on the method of the Structured Democratic Dialogue¹⁹(SDD). SDD is a modern participatory method of discussion and decision making for the management of complex problems and issues involving multidisciplinary and multi-sectoral stakeholders.

Avoiding phenomena “Groupthink” and “Erroneous Priorities Effect”

In meetings where no measures are taken to protect the authenticity of all opinions, there is risk that some participants will support views that represent the majority of the group because they do not want to “go against the group”. This results in participants reaching an apparent agreement, which only represents the “most powerful opinion”. This phenomenon is known as “Group Think”. The Structured Democratic Dialogue SDD method prevents this phenomenon by using the Nominal Group Technique, which requires equal time and equal importance to each idea/ opinion protecting the authenticity of every idea, thus ensuring that the phenomenon “Group Think” does not appear.

By definition a complex problem cannot be solved by solving all individual subproblems, but it requires exploration and detection of relations between the sub-problems. It is proven that if different stakeholders discuss and propose actions to solve a complex problem, but then choose those actions that the majority sees as important, they are likely to decide to invest in solving sub-problems, which at first seem important (in the eyes of the majority) but they might not be in reality. However, if the same stakeholders were prompted to explore the influence of an action to solve a sub-problem over another action, they would choose different actions. This phenomenon is known as Erroneous Priorities Effect.

The SDD²⁰ method utilizes a so-called Interpretive Structural Modeling (which is incorporated in the Cogniscope™ system), which eliminates this phenomenon with the use of mathematical algorithms, to ensure that the prioritization of ideas is based on the influence they have on each other.

The Structured Democratic Dialogue method is considered particularly effective in resolving multiple conflicts, interests and values and to bring the participants closer to agree on a common understanding and strategy for resolving the issue.

The implementation of SDD is performed in well-defined phases and 10 steps, where a deeper understanding of the topic it is gradually achieved and solutions in the form of actions can be identified and agreed. SDD facilitates the creation of a common understanding of the different dimensions of the topic and importantly priority is given to some ideas over others depending on their influence over each other.

Figure 3 explains the SDD method, where a complex topic is reorganized and rewritten, so that it is possible to intervene and to change. The phases of the illustration can be summarized as follows:

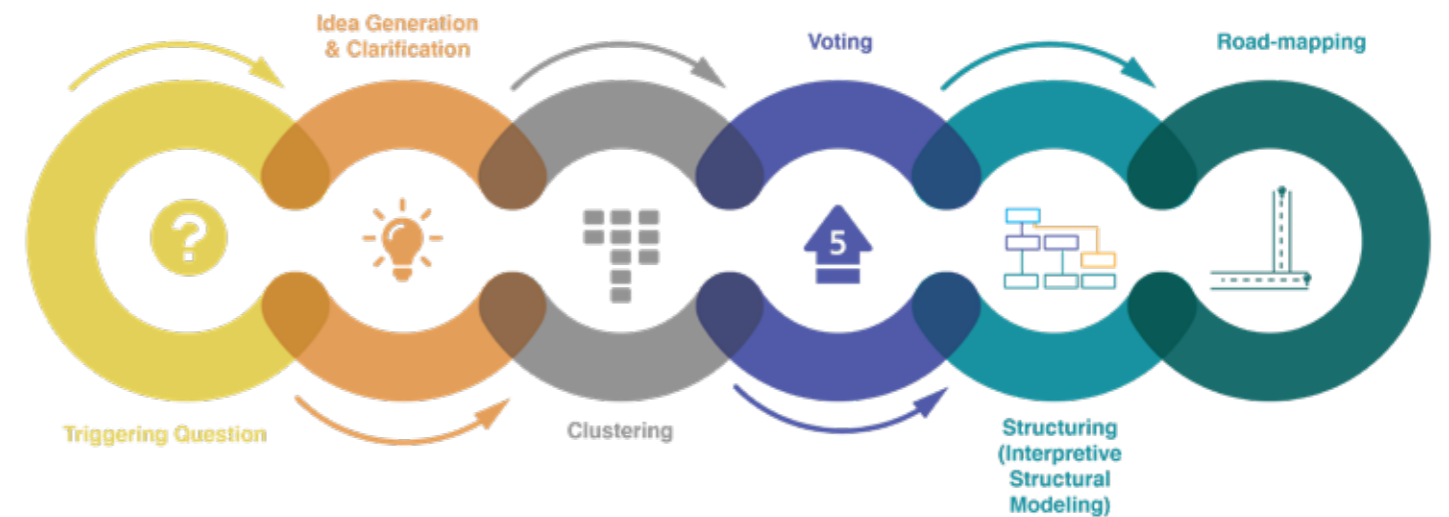


Figure 3 Phases of the SDD process and method

¹⁹SDD was developed in the 1970s with the initiators Alekos Christakis (Christakis, 1973), John Warfield (Warfield, 1982) and Hasan Özbekhan (Özbekhan, Jantsch & Christakis, 1970), in under the Club of Rome.

²⁰SDD is based scientific on 7 laws of science of complex systems (complex systems) and government (cybernetics) and it has been scientifically documented worldwide in hundreds of cases over the last 30 years. More information on the methodology of the Structured Democratic Dialogue exist in books (Christakis & Bausch, 2006; Flanagan & Christakis, 2009), websites (Wiki, 2010), simple introduction to the theory (Laouris, 2012), or earlier related applications (Laouris, Dye, Michaelides & Christakis, 2014; Laouris, Michaelides & Sapio, 2007; Laouris & Christakis, 2007).

Before the beginning of the MML Workshop

Phase 1 with steps 1 and 2: The complex problem/ topic is described and framed and a Triggering Question (TQ) is defined. This phase took place before the MML workshop and the participants received the Hot Topic description and the triggering question before arriving to the workshop. The Hot Topic was defined by XPRO (Xenia Schneider) and reviewed by CNTI (Andreas Andreou and Dr. Yiannis Laouris), ISPRA (Sasa Raicevik), Nausicaa (Iwona Gin) and EurOcean (Tiago Garcia). CNTI and particularly the facilitator of the MML workshop, Dr. Yiannis Laouris, defined the Triggering Question. Dr. Yiannis Laouris from CNTI and his team facilitated the workshop.

During the MML Workshop

All participants are sitting in a “U” formation so that they can see each other. The facilitator, Dr. Yiannis Laouris, was standing in the middle of the formation. A short presentation about the MARINA project and RRI and a briefing about the triggering question were given to the participants by Xenia Schneider.

Phase 2 with steps 3 and 4: All participants are asked to provide possible ideas/actions to the Triggering Question. One by one, the participants state and explain their ideas/actions to all other participants. This requires active participation and active listening by all. Simultaneously, the action is recorded in Cogniscope™ software. The explanations are videotaped. The explanations must be specific and understandable to all. The others participants may seek clarification, but they are prohibited from criticising the idea/ action.

Phase 3 with steps 5 and 6: All ideas/actions are grouped into categories or clusters based on similarities and common characteristics. The method requires that the clustering takes place while the participants are asked how two random ideas have enough common features to justify placing them in the same cluster (without this cluster yet existing!). This bottom-up process results in evolutionary clusters and participants benefit from an in-depth discussion around the meaning and importance of each action/ idea, enabling the creation of wider consensus regarding the hot topic discussed. Through this process, participants develop a common vocabulary and a common understanding about the various aspects of the hot topic (triggering question) being discussed. Broad consensus is achieved through discussion of possible different perceptions in relation to the meaning and importance of each idea/action. The clustering is registered in the Cogniscope™ tool. The clusters and their actions/ideas are printed and displayed on the wall, so that all participants can see them.

Phase 4 with steps 7: All participants have five votes and are asked to choose the actions/ ideas they believe can help solve the hot topic and are the most important for them. Only actions/ideas that receive votes are moving to the next and most important phase.

Phase 5 with steps 8 and 9: This phase collects the actions/ideas that have received votes and the participants collectively are asked to investigate how one action/idea can affect significantly another action/idea. The question asked is “If I execute this action/idea will it significantly affect the execution of that action/idea?” If the answer is ‘yes’ with a 75% majority, the impact is recorded and added to the Roadmap of actions/ideas. When the facilitator asks the participants to vote and the vote is about 50% Yes and 50% No, then the significance is discussed in-depth and the participants are asked to revote. As the exercise progresses a Roadmap is built, shown and discussed. The actions at the bottom of the Roadmap indicate the basic actions that must take place in order to enable the rest of the actions to be executed. Therefore, the Roadmap encourages stakeholders to prioritize causative factors.

Phase 6 with step 10: In this phase the Roadmap is discussed in detail. The actions/ideas of the lowest three levels of the Roadmap must be discussed in greater detail for defining specific activities that are SMART (Specific, Measurable, Achievable, Realistic and Time Specific). In this manner, the Roadmap becomes executable because by executing the lowest levels it allows and enables the actions of the higher levels to be consequently executed.



Executing the Mobilization & Mutual Learning Workshop

Due to its interdisciplinary nature, Marine Biotechnology is widely acknowledged at the industry and academic level as a field, which has the potential to serve and address current societal challenges related but not limited to the aspects of nutrition, aquaculture, health and medicine, environment and green energy. However, an efficient response to these challenges necessitates a new methodological perspective, which can link among others the products developed by the industry with the expectations and real needs of the citizens in a way that the products will be beneficial for the society. Through its six dimensions - Engagement, Science Education, Open Access, Gender Equality, Ethics, and Governance, Responsible Research and Innovation can serve as the facilitating force to ensure from the one hand, the sustainable development of the field of Marine Biotechnology and on the other hand, that this development does not conflict with the protection of the environment as well as the expectations of the local community.

MML Workshop Results

The following sections show all the MML Workshop Results. These results follow the phases discussed in the section above.

Phase 2: Participant Actions Based on the Triggering Question and Clarification of Actions

During the Cyprus local MML workshop, 38 ideas were generated by the participants in the form of concise action-statements through the “idea generation phase” to respond to the Triggering Question:



What Responsible Research and Innovation (RRI) actions are needed to make marine biotechnology a sustainable source of local economy in Cyprus?

The participants were requested to state their “ideas” in the form of action statements in order to “push” them to think in practical terms. In fact the facilitator from the start explained that the ideas-actions must follow the SMART principle (Specific, Measurable, Assignable, Realistic and Time-bound). Once all actions were defined, printed and displayed on the screen and on the boards in the room, the workshop passed to the Clarification Phase where one by one, the participants proceeded with the explanation of their actions. For this activity sufficient time was allocated to the rest of the participants to ask explanatory questions. The premise of the clarification phase is to allow participants to gain the same understanding and interpretation of the action based on the meaning attributed to the action by its own author. All ideas and explanations can be found in Annex 1.

Phase 3: Clustering the Actions

The third main phase of the workshop was to categorize the proposed ideas in clusters according to similarities and common characteristics. To achieve this clustering, the participants discussed and compared the ideas in pairs to identify whether they share enough characteristics to be clustered into the same category. The participants mutually and collaboratively identified eight clusters namely:

1. Research,
2. Stakeholders,
3. Incentives – Economy,
4. Risk Management,
5. No name was given to this cluster,
6. Legislation,
7. Environment and
8. Education.

The distribution of the actions across the 8 clusters is demonstrated in the below Figures:

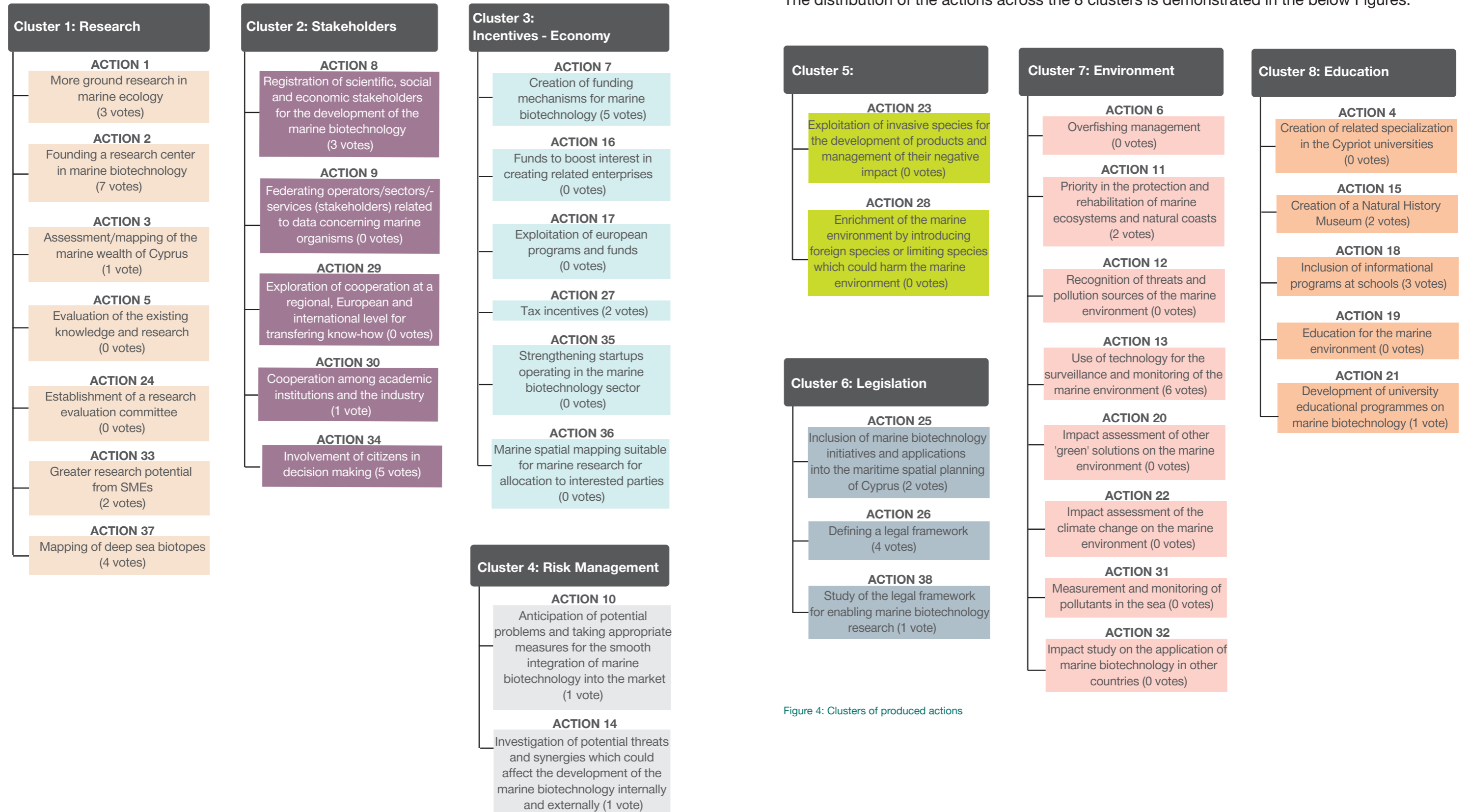


Figure 4: Clusters of produced actions

Overall, “Environment” was the most populated cluster with 8 actions followed by Research with 7 actions. An important number of actions were distributed to cluster 3: Incentives – Economy, which received 6 actions. Clusters 2: Stakeholders and 8: Education had 5 actions each. Cluster 6, related to Legislation, attracted 3 actions and finally, 2 actions were categorised under the clusters 4 on Risk Management and 5 with no name. The participants struggled to give cluster 5 a name and at the end decided to live it as shown.

Phase 4: Voting Results of all Actions

In the third phase and after the clustering, the participants were asked to read all the actions and vote. Each participant had only 5 votes that she/he could distribute the way she/he thought beneficial to answer the Triggering Question with actions. It should be observed that participants voted not necessarily on their own actions, but instead on actions that would help resolve the triggering question in the best way possible.

In total 20 actions (53%) received one or more votes and 14 actions (37%) received more than 2 votes. This shows that the participants converged their opinions towards a common vision and a common action plan. The degree of dispersion of the views of the participants’ actions/ideas is in normal range. This shows a sound basis for consensus, which will help in the effective treatment of the hot topic. It also assures that participants are all involved and all views are represented.

Only the actions/ ideas that receive at least one vote continue to the next phase. The voting results are listed in descending order based on the votes that each action received:

#	Votes	Action
2	7	Founding a research center in marine biotechnology
13	6	Use of technology for the surveillance and monitoring of the marine environment
7	5	Creation of funding mechanisms for marine biotechnology
34	5	Involvement of citizens in decision making
26	4	Defining a legal framework
37	4	Mapping of deep sea ‘biotopes
8	3	Registration of scientific, social and economic stakeholders for the development of the marine biotechnology
18	3	Inclusion of informational programs at schools
1	2	More ground research in marine ecology
11	2	Priority in the protection and rehabilitation of marine ecosystems and natural coasts
15	2	Creation of a Natural History Museum
25	2	Inclusion of marine biotechnology initiatives and applications into the maritime spatial planning of Cyprus
27	2	Tax incentives
33	2	Greater research potential from SMEs

Synthetic Analysis of the Clusters in order of total votes received

Research is considered pivotal

Cluster 1 entitled “Research” is considered the most important in terms of the number of votes received. In particular, 17 votes were distributed across the actions categorised under this cluster with an average of 2,43 votes/action and 5-6 RRI dimensions/action²¹ that is included in the influence map. Three out of the seven actions from the Research Cluster have been included in the Influence Action-Map. The actions emphasized mostly on the steps to be undertaken in order to enhance research in the sectors of marine and marine biotechnology in Cyprus. As insightfully demonstrated by the participants, despite being an island in the Mediterranean, Cyprus has no significant research in the aforementioned areas of science. The cluster involved actions, which were primarily specific, measurable, assignable and realistic and were predominantly associated with the RRI dimensions of “Open Access” and “Gender Equality”.

Action 2: “Founding a research center in marine biotechnology” (votes 7) and Action 37: “Mapping of deep-sea biotopes” (4 votes) received the highest number of votes during the voting procedure. In particular, Action 2 aims to provide physical premises for all researchers operating in the field of marine biotechnology with the purpose to extend the research outcomes in the sector allowing the creation of jobs and the development of products, which can evidently boost and provide the grounds for a sustainable economy in the country.

The analysis of the Cluster 1 shows that the successful development of the marine biotechnology sector entails both an evaluation of the existing knowledge and research, but also a realisation that the deep sea has only been mapped at a considerably low percentage providing numerous research opportunities to interested stakeholders, who strive to unlock the wealth of the deep sea diotopes in the Mediterranean and world oceans in general. The cluster addressed the SD Goal 8: Promote inclusive and sustainable economic growth, employment and decent work for all and mainly targets researchers and academia as well as the industry as well as SDG 4: Life below water.

Stakeholders are considered important in marine biotechnology

The Cluster 2 “Stakeholders” received a total of 9 votes positioning itself as the second most important cluster of the Cyprus MML workshop with 1,8 vote/action and mainly 3 RRI dimensions/ action in average. Specific, measurable and realistic actions, mostly related to the RRI dimensions of Governance, Public Engagement and Gender Equality, were generated that aimed to identify the different types of stakeholders on a national, European and international level who should be actively involved in the development of the marine biotechnology in Cyprus. Action 34 on the Involvement of citizens in decision making was the most preferable between the participants receiving 5 votes as the idea necessities the engagement of the citizens, through questionnaires or workshops, in the development of new products by the industry and the discussions for future research studies. Allowing the citizens to have a voice throughout the entire research and innovation phase, the academia and the industry will get a better understanding of how the sector can sufficiently be developed in the country while not harming the environment. The cluster mainly addressed the SD Goal 12: Ensure sustainable consumption and production patterns and targets a wide spectrum of stakeholders from business, academia and policy makers to civic society.

Sustainable Marine Environment

Cluster 7 related to the Environment received 8 votes, which were distributed across its 8 actions, that is, an average of 1 vote/action. The cluster was comprised of specific, measurable and realistic actions suggesting ideas on how to successfully implement marine biotechnology in Cyprus while respecting and protecting the marine environment. As an example, consider Action 13 (6 votes) on the use of technology (e.g. smart devices) for the surveillance and monitoring of the marine

²¹The workshop participants were asked to indicate in priority order the RRI dimensions that related in their opinion to the actions on the influence map

environment, which succeeds in linking the research and innovation process with the RRI dimensions of Public Engagement and Open Access bearing in mind that the collected data produced from the application of this action will be publicly available to any interested party, including the public. The active engagement of the research and industry community is vital to achieve the implementation of this specific cluster along with the involvement of citizens who must realise that we all lay the responsibility for securing the protection of the Cypriot beaches' biotopes. The actions of this cluster addressed the SD Goal 14: Conserve and sustainably use the oceans, seas and marine resources.

Incentives and Legislation are needed for developing the marine biotechnology sector

Cluster 3 on Incentives – Economy and Cluster 6 on Legislation received exactly the same number of votes, that is, 7 votes each. While cluster 3 illustrated the urgency of exploring financial sources that will primarily facilitate the development of marine biotechnology in Cyprus through the means of creating and easing access to funds for specialised local enterprises, cluster 6 shifted the emphasis to the definition of a legal framework to regulate the development of the sector. With regards to the Incentives – Economy cluster, a number of actions strictly associated with the RRI dimension of Governance and mainly targeting the policy makers, the industry and the researchers were suggested. Action 7 “Creation of funding mechanisms for marine biotechnology” received 5 votes out of the 7 cluster’s votes, highlighting the importance of creating funding mechanisms for marine biotechnology. Accountable for the materialisation of these mechanisms is both the public and the private sector which should be responsible for attracting funding and donations from third parties in order to allow, at first, the development of research in this underdeveloped field in Cyprus and finally, fund any innovative activities in this sector at a local level.

Cluster 6, on the other hand, incorporated specific and assignable actions related to Governance, as for instance Action 26 “Defining a legal framework”, which heavily targets the stakeholder group of policy makers who should take the lead for setting up a legal framework. The overarching goal of such a framework will be to regulate the entire field of marine biotechnology in Cyprus as it was widely agreed among the workshop participants. Policy commitment and a legal framework are needed for the successful development and further advancement of this specific field, which has the potential to produce sustainable economic benefits for the whole country.

Education is necessary for the marine biotechnology development

Cluster 8 “Education” gained a total of 6 votes distributed between 5 actions that aimed to raise awareness among pupils and students about the marine protection as well as promote the marine sector as a means of employability. To this vein, educational programs and modules about the environment and the marine environment should be taught in an interactive and participatory method at all levels of the education system to sensitise the students about the protection of the environment and the sea. The responsibility to realise the actions of this particular cluster does not lie only to the policy makers who are assigned the role of reforming the education system but also to the academic institutions which should take the lead and develop educational programmes on marine biotechnology allowing, from the one hand, the employment of local researchers at the university and the production of a new generation of researchers, on the other hand. The actions of the Education cluster addressed the SD Goal 4: Ensure inclusive and quality education for all and promote lifelong learning.

Finally, Cluster 4: Risk Management and cluster 5 were the least popular both in terms of votes received, 2 and 0 votes respectively and actions (i.e. each cluster was comprised of only 2 actions).



Tree of Influences

The process for defining the Road Map is as follows:

Two actions are randomly selected and presented in question form: “Assuming we execute the first action, could this significantly influence the execution of the second action?” Participants thoroughly discuss the influence of the two actions and if 2/3 of the votes are positive, then the relative influence of the first action on the second action is determined. Gradually after evaluating all actions in this manner, an influence action tree is created resulting in the Action Roadmap.

The mapping phase of the Cyprus Local MML workshop resulted in a very simple roadmap because the participants could not agree on evident influences among the actions. Thus, the generated roadmap could not allow further analysis and the extraction of valuable recommendations on the successful development of marine biotechnology in Cyprus.

The workshops organisers decided to ask the participants to vote a second time on actions that had received 1 vote or less in the first voting round in order to see if the rest of the non-discussed actions had mutual influences. Each participant received 3 blue stickers. The result is shown in Figure 5.



Figure 5: The picture shows the actions that received the most votes, in blue, after the second voting

The most votes during the second voting received action 2 focusing on the development of a research marine biotechnology center and action 8 for creating a complete list of stakeholders that would enable the development of marine biotechnology in Cyprus. After the second voting, the discussion of influences among action was restarted. However, again the participants did not agree that the actions had any mutual influence. The newly generated influence map (roadmap) is shown in Figure 6.

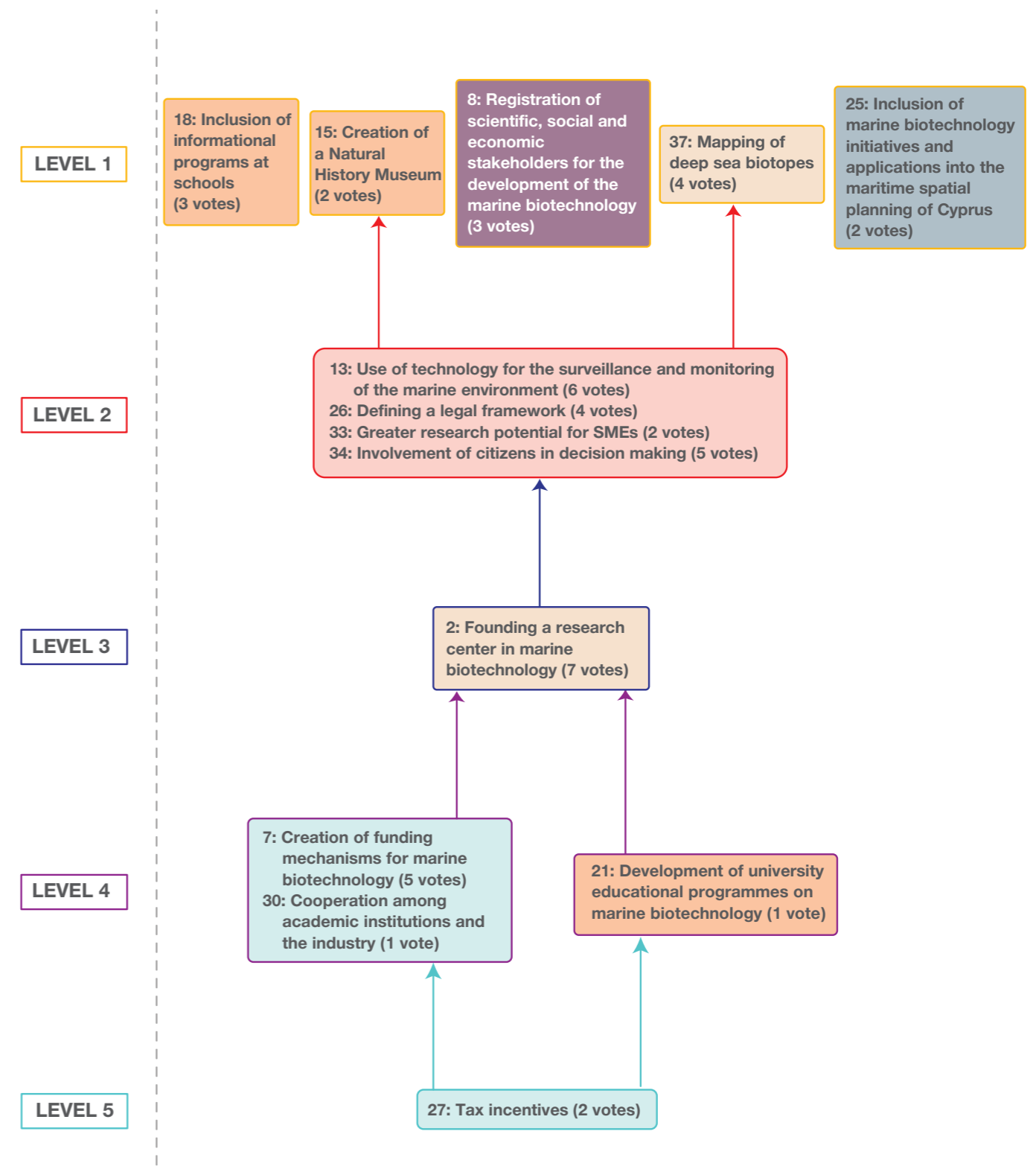


Figure 6: Final influence map produced by the participants of the local MML workshop in Nicosia, Cyprus

The influence map (roadmap) shows the 5 actions as goals at the top Level 1 and the driver actions at levels 4 and 5, and many inter-related actions in the middle (levels 2 and 3).

Mainly two reasons caused the simplicity of the map: (a) low number of participants: 9 participants attended the workshop generating a considerable amount of 38 actions which received the total amount of 35 votes (each participant possessed 5 votes) and (b) a high number of actions received 0 votes: out of the 38 actions, only 15 actions, that is, 40% of the actions received at least one vote and were further analysed to determine relations of influence among them. In the second voting round where each participant received an additional number of 3 votes with clear instructions to vote only those ideas which s/he did not vote on the first voting phase and thus 7 more actions received at least one vote and qualified to the mapping phase.

As demonstrated in Figure 6 the roadmap incorporates 5 different levels. The most influential actions are considered the root actions, which are the drivers, and similarly those, which must be implemented first to stimulate the implementation of the subsequent actions considering that the latter rely on the former. These root actions are located at the lower levels of the roadmap and in particular at the levels 5 and 4 as they have the greatest influence among all other actions. Therefore, to enable the development of the marine biotechnology sector in Cyprus, it is pivotal that the following actions are implemented firstly:

- Level 5: Tax incentives (A27, C3, V2)
- Level 4: Creation of funding mechanisms for marine biotechnology (A7, C3, V5), Cooperation among academic institutions and the industry (A30, C2, V1) and Development of university educational programmes on marine biotechnology (A21, C8, V1)

It is important to observe that the actions 7 and 30 found on Level 4 share the same box unlike action 21, which has a box on its own. This means that the actions 7 and 30 are equally influencing each other and that these actions are also influencing the actions positioned at the higher levels of the roadmap. In particular, the participants agreed that the implementation of Action 7 could significantly influence the implementation of Action 30 and that the implementation of Action 30 could significantly influence the implementation of Action 7. However, the participants answered that the implementation of Action 21 could not significantly influence the implementation of Action 7 and that explains why Action 21 is not together with Actions 7 and 30.

Level 3 is comprised of only one action, that is, Action 2: Founding a research center in marine biotechnology (C1, V:7) which was considered the most important action during the voting phase, as illustrated in Figure . The 4 actions positioned at the Level 2, namely, “Use of technology for the surveillance and monitoring of the marine environment” (A: 13, C: 7, V: 6), “Defining a legal framework” (A: 26, C: 6, V: 4), “Greater research potential for SMEs” (A: 33, C: 1, V: 2) and “Involvement of citizens in decision making” (A: 34, C: 2, V: 5) are influenced by the previous levels, which implies that in order to have a great advancement on these specific actions, the implementation of the actions identified in the previous levels must precede. It is important to note that three out of the four actions of this level, that is, Actions 13, 26, and 34, were the most important actions in the clusters 7: Environment, 6: Legislation and 2: Stakeholders respectively during the voting phase as demonstrated in Figure 4 and Figure 5.

The higher level of the roadmap, Level 1, is the most numerous one with five actions: “Inclusion of informational programs at schools” (A: 18, C: 8, V: 3), “Creation of a Natural History Museum” (A: 15, C: 8, V: 2), “Registration of scientific, social and economic stakeholders for the development of the marine biotechnology” (A: 8, C: 2, V: 3), “Mapping of deep sea biotopes” (A: 37, C:1, V: 4) and “Inclusion of marine biotechnology initiatives and applications into the maritime spatial planning of Cyprus” (A: 25, C: 6, V: 2).

Developing SMART action plans

Following the development and the analysis of the roadmap, the participants were requested to define SMART action plans, namely, actions which are Specific: How this action could be implemented?, Measurable: Which indicators could be used to measure the progress of the action?, Assignable: Who is responsible for the implementation of the action?, Realistic: What would the results of the action be? and Time-related:

When the result(s) can be achieved? in order to facilitate the implementation of the following three actions:

- Creation of funding mechanisms for marine biotechnology (A7, C3, L4, V5)²²
- Development of university educational programmes on marine biotechnology (A21, C8, L4, V1)
- Involvement of citizens in decision making (A34, C2, L2, V5)

The selection of the Actions 7 and 21 was made on the basis of how influential are considered for the implementation of the roadmap. As demonstrated in Figure 6 and discussed in detail earlier, both actions are positioned at the lower levels of the Map of Influence, at the Level 4 in particular, implying that they exercise the greatest influence towards the rest of the actions identified at the upper levels of the map. As a consequent, the successful realisation of the map heavily relies and depends on the development of concrete SMART action plans to address the specific requirements of the ideas positioned at the lower levels. Despite the fact that the Action 34 is found at the Level 2, which implies that its relationship of influence towards other ideas is significantly low, the participants however suggested to further elaborate on its implementation through SMART action plans since it is the only action found on the map related with the RRI Dimension of Public Engagement. In other words, there was a common understanding among the participants that specific actions to enhance the engagement and involvement of the citizens in the decision making process of issues concerning marine biotechnology and science in general should be identified. The demonstration of the SMART actions plans is provided as Appendix 2: SMART Action Plans.

Marine biotechnologies and Responsible Research and Innovation

How do the results relate to the RRI dimensions?

This section will analyse the actions suggested by the workshop participants in the framework of six priority dimensions of Responsible Research and Innovation: Public and Multi-stakeholder Engagement, Science Education, Open Access/Open Science, Gender Equality, Governance and Ethics as they have been defined by the European Commission²³.

The participants had generated 38 actions. These actions were classified according to the RRI dimensions. Most of them related to several RRI dimensions. The graph below illustrates how many actions related to the 6 RRI dimensions.

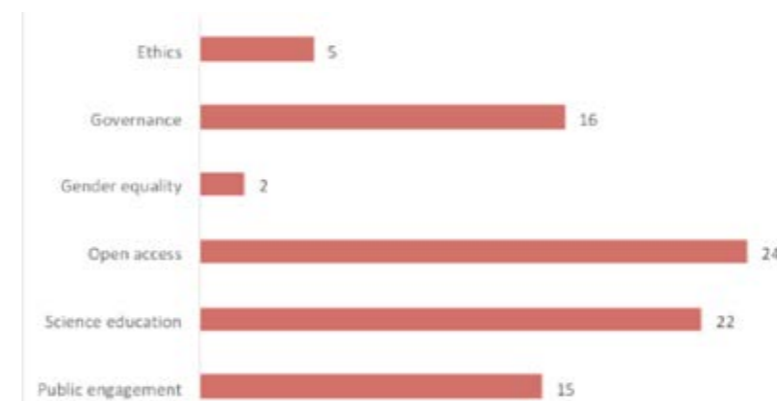


Figure 7: Number of actions that relate to RRI dimensions

N°	Action Title	Public engagement	Science education	Open access	Gender equality	Governance	Ethics	Other ¹
1	More ground research in marine ecology							
2	Founding a research center in marine biotechnology							
3	Assessment/mapping of the marine wealth of Cyprus							
4	Creation of related specialization in the Cypriot universities							
5	Evaluation of the existing knowledge and research							
6	Overfishing management							
7	Creation of funding mechanisms for marine biotechnology							
8	Registration of scientific, social and economic stakeholders for the development of the marine biotechnology							
9	Federating operators/sectors/services (stakeholders) related to data concerning marine organisms							
10	Anticipation of potential problems and taking appropriate measures for the smooth integration of marine biotechnology into the market							
11	Priority in the protection and rehabilitation of marine ecosystems and natural coasts							
12	Recognition of threats and pollution sources of the marine environment							
13	Use of technology for the surveillance and monitoring of the marine environment							
14	Investigation of potential threats and synergies which could affect the development of the marine biotechnology internally and externally							
15	Creation of a Natural History Museum							
16	Funds to boost interest in creating related enterprises							
17	Exploitation of european programs and funds							
18	Inclusion of informational programs at schools							
19	Education for the marine environment							
20	Impact assessment of other 'green' solutions on the marine environment							
21	Development of university educational programmes on marine biotechnology							
22	Impact assessment of the climate change on the marine environment							
23	Exploitation of invasive species for the development of products and management of their negative impact							
24	Establishment of a research evaluation committee							
25	Inclusion of marine biotechnology initiatives and applications into the maritime spatial planning of Cyprus							
26	Defining a legal framework							
27	Tax incentives							
28	Enrichment of the marine environment by introducing foreign species or limiting species which could harm the marine environment							
29	Exploration of cooperation at a regional, European and international level for transferring know-how							
30	Cooperation among academic institutions and the industry							
31	Measurement and monitoring of pollutants in the sea							
32	Impact study on the application of marine biotechnology in other countries							
33	Greater research potential from SMEs							
34	Involvement of citizens in decision making							
35	Strengthening startups operating in the marine biotechnology sector							
36	Marine spatial mapping suitable for marine research for allocation to interested parties							
37	Mapping of deep sea biotopes							
38	Study of the legal framework for enabling marine biotechnology research							

Figure 8: RRI dimension attribution per action

Open access was the most common dimension that appeared in 24 actions, to be followed closely by Science Education (22 actions). Governance (16 actions) and Public Engagement (15 actions) follow. Ethics relates to 5 actions and Gender Equality to 2 actions.

Figure 8 shows the attribution of the RRI dimensions to every action proposed by the participants during the workshop.

²³EU, Regulation No 1291/2013
32

The greater majority of actions relate to more than one RRI dimension. This shows that actions are multidisciplinary and involve multiple stakeholders. Three actions relate to other non-RRI dimensions. These are action 20 “Impact assessment of other ‘green’ solutions on the marine environment” that relates to “Alternative Energy” based on the meaning of the action, which refers to wind turbines; action 29 “Exploration of cooperation at a regional, European and international level for transferring know-how” that relates to “Industrial Expertise” based on the meaning of the action; and action 35 “Strengthening startups operating in the marine biotechnology sector” that relates to “Industrial Funding” also based on the statement explanation.

Only one action, that is action 10 on “Anticipation of potential problems and taking appropriate measures for the smooth integration of marine biotechnology into the market” relates to all 6 RRI dimensions.

The most important RRI dimensions for developing the Marine Biotechnology are Open Access (24 instances) and Science Education (22 instances) followed by Governance (16 instances) and Public Engagement (15 instances). This means that first the open access among sources of information must be established together with the strengthening of the educational system in marine related sciences in order to develop the sector of marine biotechnology in Cyprus.

Who are the main target stakeholder groups of the actions?

Figure below shows the number of actions that called for the involvement of each stakeholder group: the civil society (citizens/CSOs/NGOs), business/industry, researchers, policy-makers and other (mainly science communicators and journalists).

The engagement of Research & Academia followed by the equally important policy makers and implementers, and business and industry are the most important to start-up the sector of Marine Biotechnology in Cyprus.

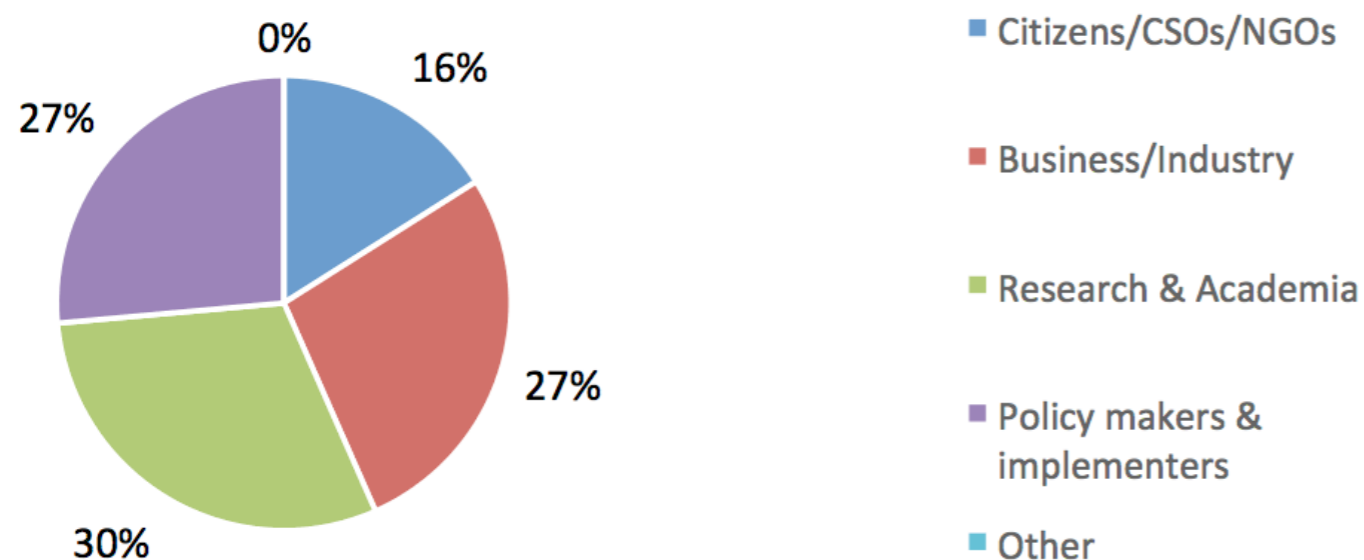


Figure 9: Stakeholder engagement needed for initiating the marine biotechnology sector in Cyprus

The figure below presents the percentage of engagement of the stakeholder groups in the clusters and the influence map (roadmap). It confirms the prominent roles of the societal stakeholders: “researchers and academia” and “business and industry” in the developing the sector of marine biotechnology in Cyprus. The policy makers are equally important in all clusters. On the other hand, public engagement was important in all clusters except in cluster 6 Legislation and cluster 5.

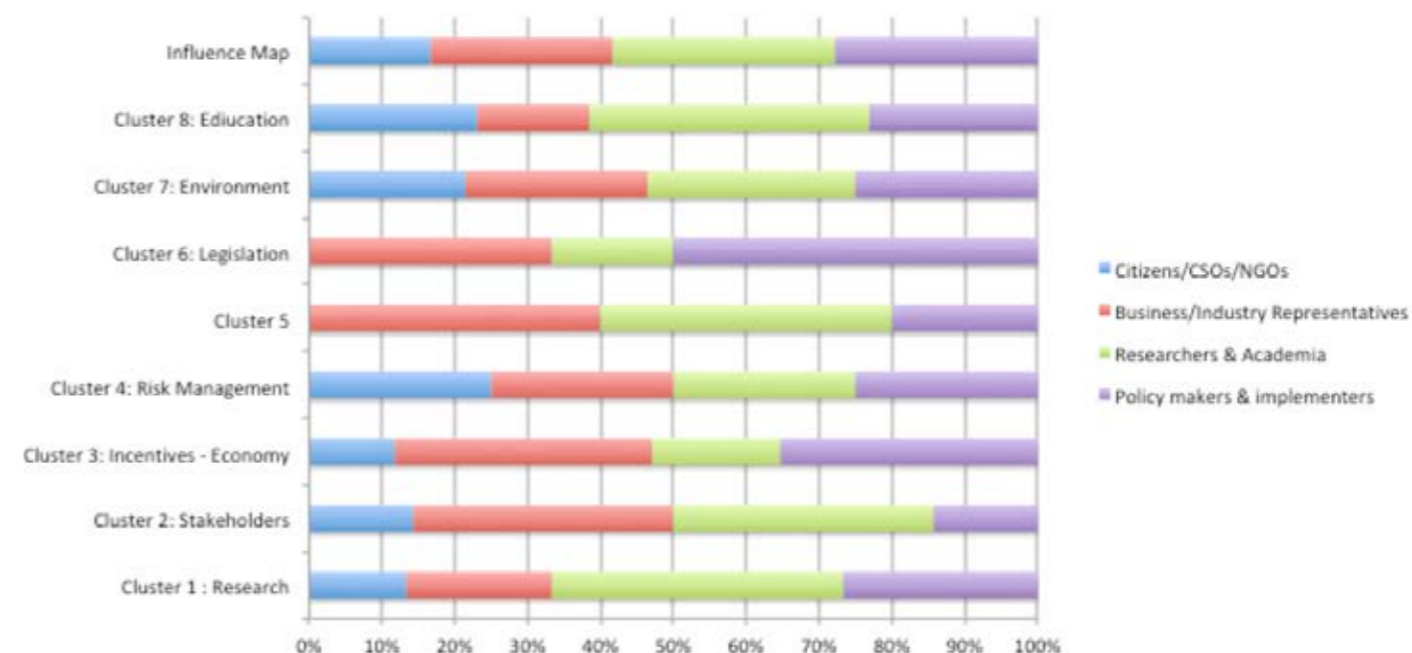


Figure 10: Stakeholder groups per cluster and influence map (roadmap)

The results confirm a strong need for close collaboration among the societal actors in order to define a clear and focused marine biotechnology strategy for the country and to better enable the blue growth in general by also embedding the RRI dimensions.



Engagement (public and multi-stakeholder)

Any product development is risky and costly. No one wants to develop a product that society is not interested to buy and use. Through public engagement, citizens, who are the consumers, can co-design and provide their views, so that the product is relevant to the society's needs. Public engagement would be beneficial for Cyprus Marine Biotechnology, since the Cypriot public is already positive for this type of blue growth.

At the same time introducing and building a new sector of activity and business in a country requires commitment and active involvement by a multitude of stakeholders. These are governmental institutions, academic and research organisations, businesses, private and public investors as well as the general public. The need of monetary and tax incentives for businesses and investors to focus on this sector were widely discussed by the participants. However, participants pointed out the need to also develop this sector in a responsible and sustainable manner and they brought many examples of “bad” and lack of management of environmental protection due to lack of oversight, ethics and governance in general.

Multi-stakeholder Engagement was a very significant dimension with 38 related actions including 13 on the roadmap.

N°	CLUSTER	ACTION	VOTES
ACTIONS ON THE ROADMAP			
2	1 Research	Founding a research center in marine biotechnology	7
13	7 Environment	Use of technology for the surveillance and monitoring of the marine environment	6
34	2 Stakeholders	Involvement of citizens in decision making	5
7	3 Incentives - Economy	Creation of funding mechanisms for marine biotechnology	5
37	1 Research	Mapping of deep sea biotopes	4
26	6 Legislation	Defining a legal framework	4
8	2 Stakeholders	Registration of scientific, social and economic stakeholders for the development of the marine biotechnology	3
18	8 Education	Inclusion of informational programs at schools	3
33	1 Research	Greater research potential from SMEs	2
25	6 Legislation	Inclusion of marine biotechnology initiatives and applications into the maritime spatial planning of Cyprus	2
15	8 Education	Creation of a Natural History Museum	2
30	2 Stakeholders	Cooperation among academic institutions and the industry	1
21	8 Education	Development of university educational programmes on marine biotechnology	1
ACTIONS NOT ON THE ROADMAP			
1	1 Research	More ground research in marine ecology	2
27	3 Incentives - Economy	Tax incentives	2
11	7 Environment	Priority in the protection and rehabilitation of marine ecosystems and natural coasts	2
3	1 Research	Assessment/mapping of the marine wealth of Cyprus	1
10	4 Market Entry	Anticipation of potential problems and taking appropriate measures for the smooth integration of marine biotechnology into the market	1
14	4 Market Entry	Investigation of potential threats and synergies which could affect the development of the marine biotechnology internally and externally	1



38	6 Legislation	Study of the legal framework for enabling marine biotechnology research	1
5	1 Research	Evaluation of the existing knowledge and research	0
24	1 Research	Establishment of a research evaluation committee	0
9	2 Stakeholders	Federating operators/sectors/services (stakeholders) related to data concerning marine organisms	0
29	2 Stakeholders	Exploration of cooperation at a regional, European and international level for transferring knowhow	0
16	3 Incentives - Economy	Funds to boost interest in creating related enterprises	0
17	3 Incentives - Economy	Exploitation of European programs and funds	0
35	3 Incentives - Economy	Strengthening startups operating in the marine biotechnology sector	0
36	3 Incentives - Economy	Marine spatial mapping suitable for marine research for allocation of interested parties	0
23	5	Exploitation of invasive species for the development of products and management of their negative impact	0
28	5	Enrichment of the marine environment by introducing foreign species or limiting species which could harm the marine environment	0
6	7 Environment	Overfishing management	0
12	7 Environment	Recognition of threats and pollution sources of the marine environment	0
20	7 Environment	Impact assessment of other 'green' solutions on the marine environment	0
22	7 Environment	Impact assessment of the climate change on the marine environment	0
31	7 Environment	Measurement and monitoring of pollutants in the sea	0
32	7 Environment	Impact study on the application of marine biotechnology in other countries	0
4	8 Education	Creation of related specialization in the Cypriot universities	0
19	8 Education	Education for the marine environment	0

Figure 11 Actions related to Engagement

It is notable that the eight most voted actions that are included in the influence map call for close engagement and collaboration among the societal actors. Specifically, action 2 “Founding a research center in marine biotechnology”, action 13 “Use of technology for the surveillance and monitoring of the marine environment” and action 34 “Involvement of citizens in decision-making” highlight this conclusion.



Science education

Marine Biotechnology is a field of tomorrow and the jobs of tomorrow are created by educating the people, who will fulfill them today. This is important that the high schools and university curricula are adjusted to meet the needs of MB. In the Cyprus national MB strategy, science education needs to be included to ensure its continuous successful execution.

Twenty-two actions including eight on the roadmap, related to Science Education making it another significant RRI dimension. A key enabler to stakeholder engagement, capacity building, development of a new sector and jobs, Science Education was a recurrent theme in the workshop.

N°	CLUSTER	ACTION	VOTES
ACTIONS ON THE ROADMAP			
2	1 Research	Founding a research center in marine biotechnology	7
13	7 Environment	Use of technology for the surveillance and monitoring of the marine environment	6
7	3 Incentives-Economy	Creation of funding mechanisms for marine biotechnology	5
37	1 Research	Mapping of deep sea biotopes	4
18	8 Education	Inclusion of informational programs at schools	3
15	8 Education	Creation of a Natural History Museum	2
33	1 Research	Greater research potential from SMEs	2
21	8 Education	Development of university educational programmes on marine biotechnology	1
ACTIONS NOT ON THE ROADMAP			
1	1 Research	More ground research in marine ecology	2
11	7 Environment	Priority in the protection and rehabilitation of marine ecosystems and natural coasts	2
3	1 Research	Assessment/mapping of the marine wealth of Cyprus	1
10	4 Market Entry	Anticipation of potential problems and taking appropriate measures for the smooth integration of marine biotechnology into the market	1
14	4 Market Entry	Investigation of potential threats and synergies which could affect the development of the marine biotechnology internally and externally	1
4	8 Education	Creation of related specialization in the Cypriot universities	0
5	1 Research	Evaluation of the existing knowledge and research	0
6	7 Environment	Overfishing management	0
9	2 Stakeholders	Federating operators/sectors/services (stakeholders) related to data concerning marine organisms	0
12	7 Environment	Recognition of threats and pollution sources of the marine environment	0
19	8 Education	Education for the marine environment	0
22	7 Environment	Impact assessment of the climate change on the marine environment	0
23	5	Exploitation of invasive species for the development of products and management of their negative impact	0
31	7 Environment	Measurement and monitoring of pollutants in the sea	0

Figure 12 Actions related to Science education

This is evident with the highest voted action 2 “Founding a research center in marine biotechnology” that received 7 votes where participants stressed that in order to be able to create a sustainable and innovative marine biotechnology sector the founding of a dedicated research center specialising in marine biotechnology is a key enabler:

- Formal education: through actions 2, 33, 1, and 4 are significant in this aspect. Participants indicated that even though Cyprus does have biologists and other marine-related scientists, none of them are able to undertake marine biotechnology research and development without specific specialisation. Thus specialised curriculum and laboratories must be developed. Furthermore, marine biotechnology can be introduced further down in the high school curricula.
- Informal education with special focus on pupils and students: such as educating the general public on their individual role in marine resource conservation and creating interest in sustainability through visits to natural history museums, aquariums, science and educational centres, outings and hands-on activities in the nature, inclusion of ocean literacy and citizen science programmes focusing on marine biodiversity, vulnerability of marine ecosystems, the potential and challenges of marine biotechnology.
- Training programmes targeting SMEs and investors so that marine biotechnology enablers and barriers can be covered. The training programmes should be in close collaboration with researchers.



Open access

For a new sector to develop, open access to information and research data that are publicly funded is necessary. Policies and business practices must be focusing on open access for faster developing the Marine Biotechnology sector but in a responsible collaborative manner.

Furthermore, Openness and sharing knowledge may lead to new ways of inspiration, innovation and profit. Consumers become interested as they favour transparency and it can be a better way for testing product development and accepting the product once it is on the market.

The participants suggested twenty seven actions favouring Open Access to data and included thirteen of them in the influence-map. The participants pointed out that Open Access/Open Science relied on the institutions' (research, business, industry and policy) willingness to share their data and that it was instrumental to boosting innovation and increasing the use of scientific results by all societal actors as well as to developing public trust and engagement.

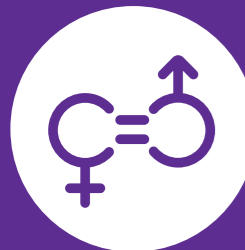
N°	CLUSTER	ACTION	VOTES
ACTIONS ON THE ROADMAP			
2	1 Research	Founding a research center in marine biotechnology	7
18	8 Education	Inclusion of informational programs at schools	3
8	2 Stakeholders	Registration of scientific, social and economic stakeholders for the development of the marine biotechnology	3
13	7 Environment	Use of technology for the surveillance and monitoring of the marine environment	6
7	3 Incentives - Economy	Creation of funding mechanisms for marine biotechnology	5
3	2 Stakeholders	Involvement of citizens in decision making	5
37	1 Research	Mapping of deep sea biotopes	4
2	6	Defining a legal framework	4
15	8 Education	Creation of a Natural History Museum	2
33	1 Research	Greater research potential from SMEs	2
25	6 Legislation	Inclusion of marine biotechnology initiatives and applications into the maritime spatial planning of Cyprus	2
21	8 Education	Development of university educational programmes on marine biotechnology	1
3	2 Stakeholders	Cooperation among academic institutions and the industry	1
ACTIONS NOT ON THE ROADMAP			
11	7 Environment	Priority in the protection and rehabilitation of marine ecosystems and natural coasts	2
10	4 Market Entry	Anticipation of potential problems and taking appropriate measures for the smooth integration of marine biotechnology into the market	1
14	4 Market Entry	Investigation of potential threats and synergies which could affect the development of the marine biotechnology internally and externally	1
6	7 Environment	Overfishing management	0
9	2 Stakeholders	Federating operators/sectors/services (stakeholders) related to data concerning marine organisms	0
12	7 Environment	Recognition of threats and pollution sources of the marine environment	0

19	8 Education	Education for the marine environment	0
22	7 Environment	Impact assessment of the climate change on the marine environment	0
23	5	Exploitation of invasive species for the development of products and management of their negative impact	0
31	7 Environment	Measurement and monitoring of pollutants in the sea	0
16	3 Incentives - Economy	Funds to boost interest in creating related enterprises	0
17	3 Incentives - Economy	Exploitation of european programs and funds	0
2	1 Research	Establishment of a research evaluation committee	0
32	7 Environment	Impact study on the application of marine biotechnology in other countries	0

ACTIONS NOT ON THE ROADMAP			
1	1 Research	More ground research in marine ecology	2
11	7 Environment	Priority in the protection and rehabilitation of marine ecosystems and natural coasts	2
3	1 Research	Assessment/mapping of the marine wealth of Cyprus	1
10	4 Market Entry	Anticipation of potential problems and taking appropriate measures for the smooth integration of marine biotechnology into the market	1
14	4 Market Entry	Investigation of potential threats and synergies which could affect the development of the marine biotechnology internally and externally	1
4	8 Education	Creation of related specialization in the Cypriot universities	0
5	1 Research	Evaluation of the existing knowledge and research	0
6	7 Environment	Overfishing management	0
9	2 Stakeholders	Federating operators/sectors/services (stakeholders) related to data concerning marine organisms	0
12	7 Environment	Recognition of threats and pollution sources of the marine environment	0
19	8 Education	Education for the marine environment	0
22	7 Environment	Impact assessment of the climate change on the marine environment	0
23	5	Exploitation of invasive species for the development of products and management of their negative impact	0
31	7 Environment	Measurement and monitoring of pollutants in the sea	0

Figure 13 Actions related to Open Access

They believed that even though Open Access/Open Science consisted in giving free online access to the results of publicly funded research (publications and data), the general public did not know how to interpret and understand them and neither did most of businesses and industry for whom knowledge transfer mechanisms were necessary. In this respect a natural history museum and cooperation among academics and industry were necessary to improve the knowledge sharing and open access to information for enabling the marine biotechnology sector in Cyprus.



Gender equality

MB will further enable gender equality since it is a new field for Cyprus and it can provide a new and equal start for all actors (male and female) in the research and innovation processes.

Gender equality did not come up as per se in the discussions of the participants of which 3 were female participants out of nine in total participants. However, when participants were asked to indicate on the influence map the RRI dimensions that they thought as important for each action, gender equality was weakly indicated as important for all actions with three participants (one female and two male).

The action that had a gender equality discussion was action 24 “Establishment of a research evaluation committee”, where participants pointed out that gender equality was important for this action.



Governance

Government must define common laws and policies and apply them without exception. Policy makers must understand the potential of marine biotechnology and create a legal framework and incentives to help develop the sector in Cyprus. At the same time, participants pointed out at lack of governance regarding to marine and coastal conservation and protection. Participants pointed to several recent examples of lack of regulation and application of rules as well as mismanagement of marine and coastal resources.

Environmental sustainability is pivotal for marine biotechnology and policies and laws must also consider how sustainability will be achieved. Defining governance is also an on-going EU and OECD initiative for shaping all different governance issues such as technical, legal and financial issues²⁴. Companies need to implement these policies and norms for aligning their interests with the needs of society. Governance is relevant for the basic research agenda setting, for the extraction of marine resources (where, how, for what, ownership).

Governance was significant with sixteen actions where five of them on the influence-map (roadmap) as shown in the table below.

N°	CLUSTER	ACTION	VOTES
ACTIONS ON THE ROADMAP			
7	3 Incentives - Economy	Creation of funding mechanisms for marine biotechnology	5
26	6 Legislation	Defining a legal framework	4
18	8 Education	Inclusion of informational programs at schools	3
25	6 Legislation	Inclusion of marine biotechnology initiatives and applications into the maritime spatial planning of Cyprus	2
27	3 Incentives - Economy	Tax incentives	2
ACTIONS NOT ON THE ROADMAP			
11	7 Environment	Priority in the protection and rehabilitation of marine ecosystems and natural coasts	2
38	6 Legislation	Study of the legal framework for enabling marine biotechnology research	1
10	4 Risk Management	Anticipation of potential problems and taking appropriate measures for the smooth integration of marine biotechnology into the market	1
14	4 Risk Management	Investigation of potential threats and synergies which could affect the development of the marine biotechnology internally and externally	1
36	3 Incentives - Economy	Marine spatial mapping suitable for marine research for allocation to interested parties	0
6	7 Environment	Overfishing management	0
12	7 Environment	Recognition of threats and pollution sources of the marine environment	0
31	7 Environment	Measurement and monitoring of pollutants in the sea	0
16	3 Incentives - Economy	Funds to boost interest in creating related enterprises	0
17	3 Incentives - Economy	Exploitation of european programs and funds	0
24	1 Research	Establishment of a research evaluation committee	0

²⁴<http://www.oecd-ilibrary.org/docserver/download/9d0e6611-en.pdf?expires=1517250336&id=id&accname=guest&checksum=9AF964424E16C1B2D6E8E02DB0F29437>



Ethics

Marine Biotechnology like any high technological and scientific field is governed by science ethics. The same applies for company practices. How can Marine Biotechnology developments be ethical towards the marine organisms used and towards the consumers that will use these products? How may Marine Biotechnology products be tested, so that they improve human living standards and do not destroy the sea ecosystems? How should Marine Biotechnology products be labeled, so that the consumer knows about it?

Marine Biotechnology is not about quick profits and companies should focus beyond this as they have a societal responsibility to follow protocols and conventions on ethical aspects.

Five actions including one on the road-map related directly to Ethics. These actions were mainly concerned with marine biotechnology as a science and the moral rules that should govern it and at the same they were focused on the sustainability of the marine environment.

N°	CLUSTER	ACTION	VOTES
ACTIONS ON THE ROADMAP			
2	1 Research	Founding a research center in marine biotechnology	7
ACTIONS NOT ON THE ROADMAP			
11	7 Environment	Priority in the protection and rehabilitation of marine ecosystems and natural coasts	2
10	4 Risk Management	Anticipation of potential problems and taking appropriate measures for the smooth integration of marine biotechnology into the market	1
14	4 Risk Management	Investigation of potential threats and synergies which could affect the development of the marine biotechnology internally and externally	1
12	7 Environment	Recognition of threats and pollution sources of the marine environment	0
24	1 Research	Establishment of a research evaluation committee	0

When participants were asked to review the actions on the road-map and indicate how the RRI dimensions to them, the majority indicated that ethics apply to all road-map actions except action 27 "Tax Incentives".

Emerging topics

During the workshop discussion the following topics emerged:

- Improve education concerning the marine environment from an early stage and inclusion of informational programs at schools.
- Enable public and private partnerships for funding marine biotechnology initiatives.
- Monitoring by involving the researchers and the public should be initiated for monitoring human pressures on the sea environment.
- More governance and holistic coastal city planning is needed to protect the coast and marine ecosystems.
- Connecting fresh water needs to marine environment effects due to desalination plants, which are increasing in number in the Mediterranean due to climate change.
- Connect academic research and public education. So far research community has been very closed worldwide. They have focused too much on individual studies and advancing knowledge and not enough on actual conservation actions. Many research results do not go into real action.



Conclusions

The participants of the workshop discussed the development of the marine biotechnology in Cyprus in the perspective of Responsible Research and Innovation. The triggering question to address this issue was What Responsible Research and Innovation actions are needed to make marine biotechnology a sustainable source of local economy in Cyprus? In response to it, they put forth proposals of participatory RRI-driven actions.

The main conclusions of the workshop were the following:

- The marine biotechnology sector is a complex multidisciplinary field that needs cooperation between public and private societal actors;
- A national strategy and a legal framework are required focusing on enabling businesses through financial and tax incentives to invest in the field of marine biotechnologies;
- A national research centre in marine biotechnology and educational programmes at university level is required;
- Creation of funding mechanisms for marine biotechnology through private public partnerships is needed;
- Marine literacy and awareness must be included in school programmes and extended to the wider public through a natural history museum;
- Citizens should participate in decision-making and in monitoring the marine and coastal environmental status;

Responsible Research and Innovation (RRI) implies a transparent and interactive process where societal actors and innovators actively collaborate to co-create solutions, services and products that are socially acceptable, sustainable and resolve important societal issues. RRI focuses on how to make research and innovation more useful to the society and how to protect the environment at the same time. Regarding how Responsible Research and Innovation (RRI) and its dimensions may enable marine biotechnology research and innovation actions, the actions focused on the following dimensions:

Open access was the most common dimension that appeared in 24 actions, to be followed closely by Science Education (22 actions). Governance (16 actions) and Public Engagement (15 actions) follow. Ethics relates to 5 actions and Gender Equality to 2 actions.

The MML workshop aimed, in particular, to enable the process for defining a common vision and an action plan for a Cypriot Marine Biotechnology strategy that will enable scientists, policy-makers, investors, SMEs and the public to address the challenges of this new marine sector and to make them aware for the need to define a national strategy for this non-existent for the island sector. Thus, the goal of this workshop was to discuss the subject of Marine Biotechnology (MB) and to define an action plan as to enable MB in Cyprus through Responsible Research and Innovation (RRI) actions.

The one day-long workshop was organised and facilitated according to the Structured Democratic Dialogue participatory method. This method allows integrating contributions from individuals with diverse views, backgrounds and perspectives through a process that is structured, inclusive and collaborative. Eighteen participants registered for the event, but only nine participants participated. The other nine did not provide any reason for not coming to the workshop. Nevertheless, the nine participants took active part in the workshop and they were motivated to treat the subject and work towards a concise action-plan. The participants came from diverse backgrounds and represented all MARINA stakeholder groups except policy-makers.



Appendix 1: List of actions and their clarifications

No	Action	Votes
1	More ground research in marine ecology No clarification	2
2	Funding a research center in marine biotechnology The centre will house all the researchers working in the field of marine biotechnology in order to extend the research outcomes in this field. These results will then be exploited for the development of products and thus boosting the economy of the country. Furthermore, new working positions will be created, specialised researchers will be employed at the centre and finally the public will become aware of the field of marine biotechnology. https://www.youtube.com/watch?v=uhF_KMgneOk	7
3	Assessment/mapping of the marine wealth of Cyprus The idea is to assess and map the current condition of the seas in Cyprus in terms of their biodiversity and pollution. A study has been conducted, I guess, by the Department of Fisheries and Marine Research investigating the reason why the seas in Cyprus are poor. However, this study should be updated. https://www.youtube.com/watch?v=mclCtxHTAdg	1
4	Creation of related specialization in the Cypriot universities No clarification	0
5	Evaluation of the existing knowledge and research The existing knowledge and research on a local, European and international level should be reviewed and in this vain, it is good to know which other programs and actions have produced valuable knowledge in the field of marine biotechnology. https://www.youtube.com/watch?v=c6q1pEI0_fo	0
6	Overfishing management Overfishing should be controlled as it impacts both the fish population as well as the balance of the marine ecosystem. It could possibly be overcome by imposing more severe fines to the offenders. https://www.youtube.com/watch?v=DAIHhJrx-b8	0
7	Creation of funding mechanisms for marine biotechnology This funding mechanism could be created with the involvement of the public and private sector. It could also receive funding and donations. This mechanism could develop research around the field of marine biotechnology, develop a legal and research library and finally fund any activities related to the marine biotechnology. https://www.youtube.com/watch?v=Gnc58RAjexY	5
8	Registration of scientific, social and economic stakeholders for the development of the marine biotechnology In order to develop the marine biotechnology, we should identify the potential stakeholders and investigate their interest. https://www.youtube.com/watch?v=eUUVQJ_4V0E	3
9	Federating operators/sectors/services (stakeholders) related to data concerning marine organisms The marine organisms hide lots of qualities which are yet to be discovered by researchers. There are various stakeholders which are directly or indirectly involved in research about marine organisms. Therefore, if we create a service/body which will horizontally coordinate all the stakeholders involved, it will boost the production of more ideas and actions as well as attract funds to be used for research. This mechanism doesn't relate to the current governance system which brings together the state, the private sector, enterprises and NGOs but it aims to link together researchers from a diverse spectrum of expertise and knowledge- Research on the degree of interest of local hotels and restaurants to buy these products. https://www.youtube.com/watch?v=TUGLS0uJvSE	0

No	Action	Votes
10	Anticipation of potential problems and taking appropriate measures for the smooth integration of marine biotechnology into the market When a new field is introduced into the market, we should identify possible problems in advance associated with its integration. For example, research outcomes could be exploited by the industry for the development of a product which should be competitive in price. Also, there should be some incentives for the consumers to choose that product and finally, the industry must guarantee the protection of the environment. Therefore, prior to the development of the marine biotechnology, a study should be developed, ideally by the government, investigating the potential problems of this new field as well as suggesting measures to overcome those problems. https://www.youtube.com/watch?v=wNnRrzwDxQ	1
11	Priority in the protection and rehabilitation of marine ecosystems and natural coasts We all have witnessed disastrous human interventions on the beaches in Cyprus during the last years as a cover for the economic crisis. However, a vision for the management of the beaches in Cyprus is lacking. Therefore, we should protect what we have and rehabilitate what can be restored. Even though Cyprus composes of a coastline of 772km, I can hardly find a natural, clean beach to swim. https://www.youtube.com/watch?v=xA8r8tvpnUo	2
12	Recognition of threats and pollution sources of the marine environment This is important in order to develop and further facilitate the sustainability of the field of marine biotechnology. https://www.youtube.com/watch?v=lj6vBM7cm4s	0
13	Use of technology for the surveillance and monitoring of the marine environment We could use technology, as for example smart devices, to survey and monitor the territorial sea in Cyprus. These data could be provided to the public also. This action could trigger the set up of new enterprises. https://www.youtube.com/watch?v=W_37WbKB5M	6
14	Investigation of potential threats and synergies which could affect the development of the marine biotechnology internally and externally Marine biotechnology is influenced by activities internally and externally. Internal activities include: desalination, construction skyscrapers which may impact the sea due to their short distance to the sea. External: there are wars and oil extraction undergoing in our area which may have negative impact on the marine environment. Some activities which could possibly boost the development of marine biotechnology may harm and destroy other activities. Similarly, stakeholders involved in the field may develop competitive attitude towards others. Therefore, we should investigate in advance potential threats and synergies. https://www.youtube.com/watch?v=MkzD5JTtXOY	1
15	Creation of a Natural History Museum A Natural History Museum is important to be created to enhance the research in the field of marine biotechnology in Cyprus bearing in mind that samples of the marine organisms (e.g. information about their qualities and features) will be stored in the museum and be available to researchers to study. Even though there are such museums in Cyprus, they don't follow the standards I mentioned in my clarification. As far as I know, the Biology Department of the University of Cyprus visions the creation of such a museum. This idea is not timely bounded as it relates to a procedure which constantly needs to be evolved and updated. https://www.youtube.com/watch?v=x98vWnla-GU	2
16	Funds to boost interest in creating related enterprises Funds should be offered from the government for the set up of new enterprises in the sector of marine biotechnology to give them the opportunity to import products developed in this field from abroad. The implementation of this action depends on the interest of the government to assist in the development of the sector by providing funds to interested companies. https://www.youtube.com/watch?v=ipolwtjcM4g	0

No	Action	Votes
17	Exploitation of European programs and funds	0
	The European funds can be exploited for the development of the sector in Cyprus which will also be beneficial for the stakeholders involved as they will be given the opportunity to develop new synergies with partners from abroad. https://www.youtube.com/watch?v=dGzy220Xm2w	
18	Inclusion of informational programs at schools	3
	No clarification	
19	Education for the marine environment	0
	From an early age, education for the environment and for the marine environment also should be established. Children must be aware that we have to protect our environment, we love the sea, we learn about the species living in the sea, we protect the nature in general. To achieve this, there should be seminars, workshops, experiments (e.g. study samples from marine species and investigate how we can produce energy). Therefore, there should be education for the marine environment covering all the levels of the education system. https://www.youtube.com/watch?v=rCekmgAqyD8	
20	Impact assessment of other 'green' solutions on the marine environment	0
	We have witnessed lots of countries which have built wind turbines in the sea. Therefore, if we plan to bring this idea also in Cyprus, it might not be ideal for our seas as we may save energy but at the same time cause damages to the environment. https://www.youtube.com/watch?v=oBAwSk_8ng4	
21	Development of university educational programmes on marine biotechnology	1
	Being an island, there are numerous researchers across Cyprus engaged in the field of marine biotechnology and therefore the universities (e.g. University of Cyprus and private universities) should take the lead and develop educational programmes on the marine biotechnology which will assist on producing a new generation of researchers and thus boosting the setting up of companies in this field. https://www.youtube.com/watch?v=Y32940Uf_aQ	
22	Impact assessment of the climate change on the marine environment	0
	The technology which will be developed in the field of marine biotechnology should consider the climate change in a way that this technology will not be influenced by any climate change because otherwise it won't be sustainable in 30 years from now. Therefore, an impact assessment can be important to understand how we deal with the causes of the climate change in order to allow the sustainability of this economy. Since climate change is not a local issue but rather expands all over the planet, it can allow people to think more socially on how we could develop economy which is beneficial for everyone. https://www.youtube.com/watch?v=7eyCfSPSDpU	
23	Exploitation of invasive species for the development of products and management of their negative impact	0
	Invasive species are those species which do not belong in the natural history of the geographical area in question. In the eastern Mediterranean, there are various consequences as part of the Lessepsian migration, the migration of marine species across the Suez Canal, from the Red Sea to the Mediterranean Sea. Therefore, it is important to think how to handle those species which cause severe consequences. The lesson learned from the single species management followed during the last years according to which some fish species were over-fished, resulted to the collapse of some species. Using this strategy, we could possibly combat some of the dangerous fish species. In our seas, we have already identified particular fish species which are dangerous for our ecosystem but at the same time have unique qualities and features, as for example the fish <i>Lagocephalus sceleratus</i> which contains tetrodotoxin making it unsuitable for nutriment. However, tetrodotoxin is used at the moment as a painkiller to sooth the pain of cancer patients at the last phases of the disease. It could possibly have some other applications also. Therefore, if could overfish this species and then extract tetrodotoxin from this fish, we could commercialise it. It might not be financially sustainable but on the one hand, it assists in the development of a new product and thus contributing in the economy and on the other hand, it limits the number of this fish in our seas considering its vast negative consequences. The lionfish is another example which can be used for the production of jewels from its impressive fins. https://www.youtube.com/watch?v=qgEM1Tms0jM	

No	Action	Votes
24	Establishment of a research evaluation committee	0
	It is necessary to establish a research evaluation committee which will evaluate all research projects in order to guarantee that their outcomes and how this research impacts the society are of some value and have a positive impact on the society. The committee should be comprised of people who have no personal interest whatsoever in the research in order to provide transparent evaluation. https://www.youtube.com/watch?v=MMt0X0JfkUk	
25	Inclusion of marine biotechnology initiatives and applications into the maritime spatial planning of Cyprus	2
	A new legislation has been lately enacted in Cyprus for the maritime spatial planning of Cyprus. According to the legislation, the maritime spatial planning refers to the process in which the government analyzes and coordinates the human activities in the coastal areas with the purpose to achieve ecologic, economic and social goals. Therefore, marine biotechnology perfectly fits into this angle. The aim of this maritime spatial planning is to contribute towards the sustainable development, the energy sector in the sea, the sea transportation, the maintenance and the protection of the environment. Therefore, marine biotechnology should be included in the discussions and the application of the planning in the next coming years because the idea is to have a plan which regulates all the sea activities. https://www.youtube.com/watch?v=ULceQq2BFSY	
26	Defining a legal framework	4
	In order to allow the development of a sustainable economy through marine biotechnology in Cyprus, it is important that the government sets up a legal framework which will define the action plan, the regulations, how this sector will be managed to facilitate the development of the economy. https://www.youtube.com/watch?v=TqJWs7SL0FE	
27	Tax incentives	2
	Companies operating in the sector of marine biotechnology should benefit some advantages, as for example tax return, their profit to be non taxable for some years as a means to use that money and expand. Also, if someone funds such a company, this person could possibly enjoy a tax-exempt status. Therefore, with no added cost on the public budget, these measures can assist the development of this new sector. https://www.youtube.com/watch?v=1bfoSlvFwsQ	
28	Enrichment of the marine environment by introducing foreign species or limiting species which could harm the marine environment	0
	We could possibly invest money to import technologies from abroad to produce certain products. Similarly, if there are certain species in our environment which harm the ecosystem, we could take some measures to minimize the danger. https://www.youtube.com/watch?v=dWiiD9jKfUk	
29	Exploration of cooperation at a regional, European and international level for transferring know-how	0
	I refer to experienced research teams which have produced products and their practices could be introduced in Cyprus. Spirullila for example is a well established product from abroad which is produced at the lab in Cyprus without interfering with the marine ecosystem. Therefore, we could create synergies with experts from abroad to train the local companies and thus transfer know-how to Cyprus. https://www.youtube.com/watch?v=Tm4rZI_eMS8	
30	Cooperation among academic institutions and the industry	1
	The industry should be aware of the research projects undertaken by academic institutions at a given time as well as their expected outcomes in order to understand on which field to invest later and avoid any conflict of interest. Therefore, cooperation and communication between them is important. https://www.youtube.com/watch?v=vooQ3uckhmc	
31	Measurement and monitoring of pollutants in the sea	0
	We should find a way to measure the pollution in the sea and suggest measures to overcome. Also, we should monitor the pollution to understand where it gets worse or not and whether the measures taken are effective. https://www.youtube.com/watch?v=pGHYTdr-TUY	

No	Action	Votes
32	Impact study on the application of marine biotechnology in other countries We could cooperate with other countries which have applied marine biotechnology and study the pro and cons of those applications https://www.youtube.com/watch?v=YoRQ-uNYml0	0
33	Greater research potential from SMEs It's difficult for an enterprise in the private sector to conduct research without funding. Therefore, the idea related to the establishment of a funding mechanism should also target the financial needs of Small and Medium Enterprises. There should also be a fixed, governmental funding to serve these purposes, which at the moment doesn't exist in Cyprus. The core objective of this idea is that funding, either governmental or through investments, should be accessible to Small and Medium Enterprises for research purposes. https://www.youtube.com/watch?v=Qm2UbXlxOX8	2
34	Involvement of citizens in decision making This involvement can be achieved through questionnaires or workshops in which we can grasp the opinion of the citizens regarding some new products or research studies to be undertaken. We will then be able to expand our point of view by listening to different opinions (e.g. citizens, tourists) and have a better understanding on how marine biotechnology could be applied in Cyprus. https://www.youtube.com/watch?v=H2cdauNjizl	5
35	Strengthening startups operating in the marine biotechnology sector Accessing funding seems to be a huge problem and especially for start-ups that need money promptly to start their operations. Therefore, many start-ups give up simply because they don't have the money needed to start their business and this becomes even more problematic considering that banks do not provide loans to enterprises without a track record. https://www.youtube.com/watch?v=F6K_9zRPedA	0
36	Marine spatial mapping suitable for marine research for allocation to interested parties A good governmental incentive is to divide and further allocate to interested parties marine areas for certain purposes. https://www.youtube.com/watch?v=a5Zpgr9qstA	0
37	Mapping of deep sea biotopes More than 80% of the bottom surface is not mapped which means that we have no knowledge of what is out there. Therefore, we should map the deep sea biotopes in the Mediterranean and globally also. https://www.youtube.com/watch?v=qWZkpUa1kug	4
38	Study of the legal framework for enabling marine biotechnology research Is there a national or international legal framework which regulates our actions? Maybe we should introduce other legal frameworks which will regulate the operations of an enterprise? Therefore, we should know where we are standing in terms of legislation before we introduce a new technology. https://www.youtube.com/watch?v=ABDSJdYAXQg	1



Appendix 2: SMART Action Plans

Development of university educational programmes on marine biotechnology (A21, C8, L4, V1)				
S	M	A	R	T
Specific How this action could be implemented?	Measurable Which indicators could be used to measure the progress of the action?	Assignable Who is responsible for the implementation of the action?	Realistic What would the results of the action be?	Time-related When the result(s) can be achieved?
<ul style="list-style-type: none"> Via the direct involvement of the Ministry of Education and the Universities EU funding with the aim to define the content and the structure of the educational programmes and curriculum Informing the students about the existence of these programmes Inclusion of these programmes at the university curriculum 	<ul style="list-style-type: none"> Defining the structure of the programme Meetings to discuss the structure and the goals of the programmes Implementation timeframe Number of courses introduced Number of graduates 	<ul style="list-style-type: none"> The Ministry of Education Universities The Marine Biotech Fund 	<ul style="list-style-type: none"> It is expected that the educational programmes (master degree) will educate new scientists and create an industry to accommodate both the public and the scientists More researchers specialised in this field 	<ul style="list-style-type: none"> 4-10 years

Creation of funding mechanisms for marine biotechnology (A7, C3, L4, V5)				
S	M	A	R	T
Specific How this action could be implemented?	Measurable Which indicators could be used to measure the progress of the action?	Assignable Who is responsible for the implementation of the action?	Realistic What would the results of the action be?	Time-related When the result(s) can be achieved?
<ul style="list-style-type: none"> EU funds Governmental funds Bringing together stakeholders and investors to discuss and develop a plan of action to support marine biotechnology Specific provisions could be included in the national budget 	<ul style="list-style-type: none"> Development of the action plan Implementation of the action plan Creation of the funding mechanism Compile of data from interested stakeholders Launching of the support plan from the funding mechanism The amount of funds raised The dissemination of funds into projects Amounts of funds distributed 	<ul style="list-style-type: none"> Banks Investment vehicles Research funding agencies Government Parties related (quasi-public) to the sector of marine biotechnology 	<ul style="list-style-type: none"> Increase interest from interested people and SMEs to receive funding from the mechanism Submission of applications and implementation of a funding plan Enhancement of Marine Biotech in Cyprus Access to funds for stakeholders interested in operating in this industry 	<ul style="list-style-type: none"> 5-10 years

Involvement of citizens in decision making (A34, C2, L2, V5)				
S	M	A	R	T
Specific How this action could be implemented?	Measurable Which indicators could be used to measure the progress of the action?	Assignable Who is responsible for the implementation of the action?	Realistic What would the results of the action be?	Time-related When the result(s) can be achieved?
<ul style="list-style-type: none"> Inform the public about the benefits of marine biotechnology for the economy and improvement of the quality of life. The public to participate in discussions with policy and decisions makers Create an open association, advertisement of its scope and actions and call for inputs Public participation at the decision making process by law 	<ul style="list-style-type: none"> Number of citizens participating at discussions with policy and decisions makers Number of positive votes from citizens Informative workshops on marine biotechnology and on the pending decisions/provisions to be voted Number of inputs received Number of people involved and actions taken Number of interventions proposed by the public 	<ul style="list-style-type: none"> NGOs in collaboration with civic society A committee with people related to the sector (scientists, consultants etc.) Responsible Ministry 	<ul style="list-style-type: none"> Increased engagement of citizens in the decision making process Active involvement of citizens at discussions with decision and policy makers Enhancement of responsible attitude of citizens towards public affairs Further involvement of all public stakeholders to this sector and the impact of actions taken. Easier acceptance of decisions on marine biotechnology 	<ul style="list-style-type: none"> 2-4 years

Appendix 3: Participants

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