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NAUTILOS

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DEC	Websites, patents, filing, etc.	
DEM	Demonstrator	
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PU	Public	X
CO	Confidential, only for members of the consortium (including the Commission Services)	

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NAUTILOS

List of Acronyms and Abbreviations

Abbreviation	Definition
ABI	Animal Borne Instruments
AGA	Annotated Grant Agreement
AniBOS	Animal Borne Ocean Sensors
AtlantOS	Optimising and Enhancing the Integrated Atlantic Ocean Observing Systems
BG	Blue Growth
CA	Consortium Agreement
CMEMS	Copernicus Marine Environmental Monitoring Service
CTD	Conductivity, Temperature and Depth
DESCA	Development of a Simplified Consortium Agreement
DMP	Data Management Plan
DTO	Digital Twin of the Ocean
EAB	External Advisory Board
EC	European Commission
EMODnet	European Marine Observation and Data Network
ESPCE	European Strategy for Plastics in a Circular Economy
EU	European Union
EuroGOOS	European Global Ocean Observing System
FP7	7th Framework Programme (EU Research and Innovation)
GA	Grant Agreement
GOOS	Global Ocean Observing System
H2020	Horizon 2020 EU Research and Innovation Framework Programme
HE	Horizon Europe EU Research and Innovation Framework Programme
HEI	Higher Education Institution
ID	Identification
INS-TAC	In Situ Thematic Centre
IOC	Intergovernmental Oceanographic Commission
IP	Intellectual Property
IPR	Intellectual Property Rights
ISC	International Science Council
JCOMMPS	Joint Technical Commission for Oceanography and Marine Meteorology in situ Observations Programme Support Centre
JV	Joint Venture
KER	Key Exploitable Result
MASTS	Marine Alliance for Science and Technology for Scotland
MEOP	Marine Mammals Exploring the Oceans Pole to Pole

NAUTILOS	New Approach to Underwater Technologies for Innovative, Low-cost Ocean obServation
NGO	Non-Governmental Organisation
OA	Open Access
OceanOPS	Joint Centre for Oceanography and Marine Meteorology in situ Observations Programmes Support
OCG	Observation Coordination Groups
PO	Parent Organisation
R&D	Research and Development
RfP	Rules for Participation
SDG	Sustainable Development Goals
SME	Small and Medium-sized Enterprise
SO	Specific Objectives
TechOceanS	Technologies for Ocean Sensing
TIB	Technology and Innovation Board
UN	United Nations
UNCLOS	United Nations Convention on the Law of the Sea, 1982
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organisation
WBS	Work Breakdown Structure
WMO	World Meteorological Organization
WP	Work Package

Executive Summary

This deliverable is the first version of the NAUTILOS Exploitation Strategy produced at the beginning of the project, therefore, the general context of how the NAUTILOS project and Consortium has come to be is addressed as well as the general direction and path to follow as a newly formed "organization" in the world to contribute to the "Blue Economy" and the furthering of knowledge of our surroundings. This NAUTILOS Exploitation Strategy will be updated towards the end of project, building upon the activities achieved, to allow for internal reflections as well as lesson's learned for others. Naturally the post project vision will be sought in the final version. Therefore, this initial version of the NAUTILOS Exploitation Strategy is split into two sections:

1.   Exploitation Strategy
2.   IPR Management Strategy

The Exploitation Strategy covers the overall context in which the NAUTILOS project exists and the various objectives and stakeholders involved at European and worldwide level. Based on this a first version of the NAUTILOS Strategy Statement is produced which includes the Strategic Intent, Mission Statement and Vision along with the goals and objectives envisaged to achieve.

The IPR Management Strategy covers the overall strategy, context, avenues and constraints of the diverse aspects related to intellectual property, its rights and obligations in the context of the consortium and the project as a whole. This includes an overview of the access rights and existing IPRs to be considered (i.e. Background, Foreground, Sideground, Postground), associated risk analysis and mitigation measures are also covered.

1. Exploitation Strategy

A. Introduction

NAUTILOS[1] is the project constructed by the consortium led by CNR that was successful in response to the Call for Proposals: *H2020-BG-2020-1[2]* under the *BG-07-2019-2020 – The Future of Seas and Oceans Flagship Initiative: Part [C] 2020 – Technologies for observations*.

NAUTILOS is one of two projects selected out of 11 candidate proposals, where the other winning project, *TechOceanS[3]*, is led by the *National Oceanography Centre*, and in the spirit of EU collaboration can be a source of synergies and experience sharing.

B. European strategic context for NAUTILOS

The ***BG-07-2019-2020 – The Future of Seas and Oceans Flagship Initiative***, itself exists within the EU *Blue Growth* strategy, funded within the ***Horizon 2020 (H2020) Framework Programme*** under the "***Food security, sustainable agriculture and forestry, marine, maritime and inland water research and the bioeconomy***" research line of action.

The basis for the EU's H2020 programmes for marine and maritime research and innovation comes in part from «**A European Strategy for Marine and Maritime Research**» document[4] from 2008 that supports initiatives, such as the FP7 Ocean of Tomorrow calls, to further our understanding of the marine environment, its climatic and non-climatic stressors and to promote the sustainable use of marine resources.

i. Blue Growth Strategy

Blue Growth[5] is a long-term strategy to support sustainable growth in the marine and maritime sectors as a whole. The 'blue' economy represents roughly **5.4 million jobs** and generates a **gross added value of almost €500 billion a year in the European area** alone. The ideal was adopted in part with reference to economics reflections by Gunter Pauli[6] and the Blue Economy[7].

The **Blue Growth strategy** consists of **three** components:	NAUTILOS link
1. Develop sectors that have a high potential for **sustainable jobs** and **growth**, such as:	
a. Aquaculture[8] (Fisheries website)	Direct link
b. Coastal tourism[9]	Partial link
c. Marine biotechnology[10]	Direct link
d. Ocean energy[11]	No link

[1] https://cordis.europa.eu/project/id/101000825
[2] https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/topic-details/bg-07-2019-2020
[3] https://cordis.europa.eu/project/id/101000858
[4] https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2008:0534:FIN:EN:PDF
[5] https://ec.europa.eu/maritimeaffairs/policy/blue_growth_en
[6] https://www.gunterpauli.com/blog/blue-growth
[7] https://www.theblueeconomy.org/
[8] http://ec.europa.eu/fisheries/cfp/aquaculture/index_en.htm
[9] https://ec.europa.eu/maritimeaffairs/policy/coastal_tourism
[10] https://ec.europa.eu/maritimeaffairs/policy/biotechnology
[11] https://ec.europa.eu/maritimeaffairs/policy/ocean_energy

e. Seabed mining[12]	No link
2. Essential components to provide **knowledge**, **legal certainty** and **security** in the blue economy	
a. **Marine knowledge**[13][14]to improve access to information about the sea;	Direct link
b. **Maritime spatial planning**[15] to ensure an efficient and sustainable management of activities at sea;	No link
c. **Integrated maritime surveillance**[16] to give authorities a better picture of what is happening at sea.	No link
3. **Sea basin strategies** to ensure tailor-made measures and to **foster cooperation** between countries	
a. Adriatic and Ionian Seas[17]	Direct link
b. Arctic Ocean[18]	Antarctic link
c. Atlantic Ocean[19]	Direct link
d. Baltic Sea[20]	Direct link
e. Black Sea[21]	No link
f. Mediterranean Sea[22]	Direct link
g. North Sea[23]	Partial link

Table 1 – Comparison of the Blue Growth Strategy components and links to NAUTILOS

ii. The Blue Growth Call within the Blue Growth Strategy

The Blue Growth strategy[24] implemented in the Horizon 2020 programme was adapted to tackle the following necessities warranting European Union funding[25] in the Blue Growth Call topics (2018-2019):
1. Climate and Oceans
   o Sustainable harvesting of marine biological resources
   o Coordination of marine and maritime research and innovation in the Black Sea
2. Food and Oceans
   o Sustainable European aquaculture 4.0: breeding and feeding
3. Marine Value Chains
   o Multi-use of the marine space, offshore and near-shore: pilot demonstrators
4. Land and Sea
   o Sustainable solutions for bio-based plastics on land and sea

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[12] https://ec.europa.eu/maritimeaffairs/policy/seabed_mining
[13] https://ec.europa.eu/maritimeaffairs/policy/marine_knowledge_2020
[14] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=SWD:2014:149:FIN
[15] https://ec.europa.eu/maritimeaffairs/policy/maritime_spatial_planning
[16] https://ec.europa.eu/maritimeaffairs/policy/integrated_maritime_surveillance
[17] https://ec.europa.eu/maritimeaffairs/policy/sea_basins/adriatic_ionian
[18] https://ec.europa.eu/maritimeaffairs/policy/sea_basins/arctic_ocean
[19] https://ec.europa.eu/maritimeaffairs/policy/sea_basins/atlantic_ocean
[20] https://ec.europa.eu/maritimeaffairs/policy/sea_basins/baltic_sea
[21] https://ec.europa.eu/maritimeaffairs/policy/sea_basins/black_sea
[22] https://ec.europa.eu/maritimeaffairs/policy/sea_basins/mediterranean_sea
[23] https://ec.europa.eu/maritimeaffairs/policy/sea_basins/north_sea
[24] https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX%3A52012DC0494
[25] PDF of EU Commission presentation – missing weblink

5. **International Cooperation**
   - o All Atlantic Ocean Research Alliance
   - o **The Future of Seas and Oceans – (NAUTILOS arises from call topic launched here)**
   - o Towards a Baltic and North Sea research and innovation programme
6. Blue Bioeconomy Public-Public-Partnership

In total 9 topics, with a value of 166.5 M€

Therefore, within the "**International Cooperation**" is the "**The Future of Seas and Oceans**" initiative and subsequently the call topic that the NAUTILOS consortium successfully responded to, and naturally always exists within the overall Blue Growth strategy as the Blue Growth Call.

This Blue Growth Call aims at sustainably harvesting the potential of resources from seas, oceans and inland waters for different uses and across the range of marine and maritime industries, while protecting biodiversity and enhancing climate resilience. It supports sustainable growth in the marine and maritime sectors through a responsible management of marine resources for healthy, productive, safe, secure and resilient seas and oceans, which are essential for thriving ecosystems, climate regulation, global food security, human health, livelihoods and economies.

This call will boost the blue economy by:
   - i) Improving our integrated knowledge about the reciprocal impact of climate change on marine ecosystems and biological resources in order to effectively manage their response, mitigation and resilience capacities;
   - ii) Preserving and sustainably exploiting marine and coastal ecosystems, and biological resources to deliver improved nutrition and health;
   - iii) De-risking major investments and boosting blue innovations on land and at sea to develop new bio-based marine value chains and open up new markets;
   - iv) Developing smart and connected territories between land and sea; and
   - v) Strengthening the international research and innovation cooperation around seas and oceans, to promote a globally sustainable blue economy.

Activities shall improve ocean observations - in support of the *G7 Future of the Seas and Oceans Initiative* - to better predict and mitigate the impact of stressors and changes (including sea-level rise), and the exploration of marine resources, including enhancing the access and management of data and services ("blue cloud").

They will tap into the potential of marine resources, including plankton and microbiomes, and aquatic production systems, from fisheries to aquaculture [[In this context, 'aquaculture' comprises the farming of aquatic organisms (including fish, shellfish, algae and aquatic plants) in all types of controlled or natural water environments (freshwater, brackish and seawater).]], for better food and nutrition security, health and bio-based products as well as climate change mitigation.

Major international cooperation activities will also be launched, focusing on the South Atlantic Ocean and paving the way towards an 'All Atlantic Ocean Research Alliance' [[Belém Statement on Atlantic Research and Innovation Cooperation, Commission Decision C(2017)3551/F1, full reference to be introduced upon Council approval in mid July 2017.]], and reinforcing cooperation with partners in other regions such as the Baltic Sea and the North Sea, the Mediterranean and the Black Sea.

All Blue Growth actions shall also contribute to improving science education and ocean literacy through dissemination, outreach and training activities.

A strategic coordinated approach for marine and maritime research across all parts of Horizon 2020 will support the implementation of relevant EU policies to help deliver key Blue Growth objectives across Europe, including the EU Outermost Regions. This will also involve relevant topics from other parts of Horizon 2020 in addition to Societal Challenge 2, which will be interlinked through a Blue Growth topics flagging system.

The Blue Growth Call is intended to deliver on a series of EU policies and international commitments, including the:

No.	Blue Growth	BG-07 Future of Seas and Oceans Flagship Initiative
1	EU Bioeconomy Strategy	Part of Expected Impact of Call
2	2030 Climate and Energy Framework	
3	Circular Economy Package	Part of Expected Impact of Call
4	Common Fisheries Policy	Part of Expected Impact of Call
5	Integrated Maritime Policy	
6	Marine Strategy Framework Directive	Part of Expected Impact of Call
7	Maritime Spatial Planning Directive	Part of Expected Impact of Call
8	Blue Growth Strategy	Part of Expected Impact of Call
9	International Ocean Governance: an agenda for the future of our oceans	Supports the Collaborative Research Action on Oceans of the **Belmont Forum**[26] and the **International Ocean Governance Communication**[27].
10	**UN 2030 Sustainable Development Agenda**[28], in particular:	
	• SDG 2 'Zero hunger' • SDG 13 'Climate action' • SDG 14 'Life below water'	• SDG 2 'Zero hunger' • SDG 13 'Climate action' • SDG 14 'Life below water' • SDG 15 'Life on land' [mentioned only in call topic description]

Table 2 – Comparison of Policies & Commitments of the Blue Growth & BG-07 Initiatives

The Blue Growth Call also contributes to the following Focus Areas:
- 'Building a low-carbon, climate resilient future',
- 'Digitising and transforming European industry and services' and
- 'Connecting economic and environmental gains – the Circular Economy'.

This Future of Seas and Oceans Flagship Initiative (TOPIC ID: BG-07-2019-2020) action will contribute to make ocean observations and data management in European seas and the Atlantic Ocean fit for the future, in line with the G7 Future of the Oceans Initiative (Tsukuba Communiqué of the G7 Science Ministers[29]).

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[26] Belmont Forum https://www.belmontforum.org/
[27] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=JOIN:2016:49:FIN
[28] https://sdgs.un.org/2030agenda
[29] http://www8.cao.go.jp/cstp/english/others/20160517communique.pdf

iii. Other complementary initiatives

Due to their relevancy, the following complementary activities to the NAUTILOS project will be described below:

- ESPCE - European Strategy for Plastics in a Circular Economy
- IOC - Intergovernmental Oceanographic Commission
- EMODnet - European Marine Observation and Data Network
- EuroGOOS - European Global Ocean Observing System
- EU Green Deal
- DTO – Digital Twin of the Ocean
- CMEMS – Copernicus Marine Environmental Monitoring Service
- EU Horizon Europe

ESPCE - European Strategy for Plastics in a Circular Economy

Given the growing concern of plastics in society and particularly the effect on the oceans and seas around the world, it is important to keep in mind some important facts shown below that come from the EU itself to engage stakeholders via a dedicated brochure[30] "**A European Strategy For Plastics In A Circular Economy**" as well as the communication **(COM/2018/028 final)**[31] from the Commission on "A European Strategy For Plastics In A Circular Economy". Within this reality NAUTILOS partners will perform activities to detect plastics and micro-plastics to address this issue.

Very large quantities of plastic waste leak into the environment from sources both on land and at sea, generating significant economic and environmental damage. **Globally, 5 to 13 million tonnes of plastics — 1.5 to 4 % of global plastics production — end up in the oceans every year**[32]. It is estimated that **plastic accounts for over 80 % of marine litter**. Plastic debris is then transported by marine currents, sometimes over very long distances. They can be washed up on land[33], degrade into microplastics or form dense areas of marine litter trapped in ocean gyres. **UNEP estimates that damage to marine environments is at least USD 8 billion per year globally**.

In the EU, **150 000 to 500 000 tonnes[34] of plastic waste enter the oceans every year**. This represents a small proportion of global marine litter. Yet, plastic waste from European sources ends up in particularly vulnerable marine areas, such as the Mediterranean Sea and parts of the Arctic Ocean. **Recent studies show plastics accumulate in the Mediterranean at a density comparable to the areas of highest plastic accumulation in the oceans**. Plastic pollution also affects areas of the European Exclusive Economic Zone, in the outermost regions along the Caribbean Sea, the Indian, Pacific and Atlantic Oceans. **In addition to harming the environment, marine litter causes economic damage to activities such as tourism, fisheries and shipping**. For instance, the cost of litter to EU fisheries was estimated at about 1 % of total revenues from catches by the EU fleet[35].

Microplastics, tiny fragments of plastic **below 5mm in size**, accumulate in the sea, where their small size makes it easy for marine life to ingest them. **They can** also **enter the food chain**. Recent studies also found microplastics in air, drinking water and other foods like salt or honey, with yet unknown impacts on human health. **In total, it is estimated that between 75 000 and 300 000 tonnes of**

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[30] https://ec.europa.eu/environment/circular-economy/pdf/plastics-strategy-brochure.pdf

[31] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2018:0028:FIN

[32] Jambeck et al, Plastic waste inputs from land into the ocean, Science, February 2015

[33] Including on uninhabited land, for example see http://www.pnas.org/content/114/23/6052.abstract

[34] http://ec.europa.eu/environment/marine/good-environmental-status/descriptor-10/pdf/MSFD%20Measures%20to%20Combat%20Marine%20Litter.pdf

[35] Joint Research Centre, Harm Caused by Marine Litter, 2016.

microplastics are released into the environment each year in the EU[36]. While a large amount of microplastics result from the fragmentation of larger pieces of plastic waste, significant quantities also enter the environment directly, making it more challenging to track and prevent them.

Measures - 2018 onwards: Curbing plastic waste and littering	NAUTILOS link
Actions to tackle sea-based sources of marine litter: – Adoption of a **legislative proposal on port reception facilities** for the delivery of waste from ships – development of **measures to reduce loss or abandonment at sea of fishing gear** (e.g. including recycling targets, EPR schemes, recycling funds or deposit schemes) – development of **measures to limit plastic loss from aquaculture** (e.g. possible Best Available Techniques Reference Document)	Indirect link
Actions to monitor and curb marine litter more effectively: – improved **monitoring and mapping of marine litter, including microplastics**, on the basis of EU harmonised methods – support to Member States on the implementation of their programmes of **measures on marine litter** under the **Marine Strategy Framework Directive**, including the link with their **waste/litter management plans** under the **Waste Framework Directive Harnessing global action**	Direct link
Actions focusing on key regions: – project to reduce **plastic waste and marine litter in East and South-East Asia** to support sustainable consumption and production, the promotion of the waste hierarchy and extended producer responsibility, and improve recovery of fishing gear – examining options for specific action to **reduce plastic pollution in the Mediterranean**, in support of the implementation of the Barcelona Convention – cooperation on **plastic waste prevention in major world river basins**	Direct link
Actions in support of multilateral initiatives on plastic: – renewed engagement on **plastics and marine litter** in fora such as the UN, G7, G20, the MARPOL convention and regional sea conventions, including the **development of practical tools and specific action on fishing and aquaculture**. – support to action under the Basel Convention, particularly for the **implementation of the toolkit on environmentally sound waste management.**	Indirect link

Table 3 – Comparison of the European Strategy for Plastics in a Circular Economy measures and links with NAUTILOS

IOC - Intergovernmental Oceanographic Commission

Given the "international cooperation" remit of the EU's Blue Growth strategy, the NAUTILOS project will naturally take into consideration the Intergovernmental Oceanographic Commission (IOC)[37] of UNESCO[38]. The IOC is similarly committed to the UN SDG 14 and sustainable oceans by 2030, and is the only intergovernmental organization with a specific mandate in marine scientific research, services and capacity building in all of the world's ocean basins. Furthermore, the NAUTILOS project will seek to work proactively within the framework of the 1982 United Nations Convention on the Law of the Sea (UNCLOS)[39] which established a comprehensive legal framework for the oceans and seas, including providing a legal framework for the conservation and sustainable use of oceans and their resources.

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[36] Source: Eunomia.
[37] https://ioc.unesco.org/
[38] https://en.unesco.org/
[39] https://www.un.org/depts/los/convention_agreements/texts/unclos/unclos_e.pdf

Within UNCLOS, there is a number of provisions dealing with marine scientific research and the transfer of marine technology, and calls for all States to cooperate in accordance with their capabilities to promote actively the development and transfer of marine science and marine technology on fair and reasonable terms and conditions in order to help developing countries to access the benefits of the oceans and seas. Therefore, the NAUTILOS project will naturally use the IOC's reference document on the subject to guide its activities, the "Transfer of marine technology: knowledge sharing and capacity development for sustainable ocean and coastal management[40]" to facilitate the possible exploitation of activities with other entities such as via the transfer of marine technology.

EMODnet - European Marine Observation and Data Network

The European Marine Observation and Data Network[41] (**EMODnet**), provides access to European marine data across seven discipline-based themes:

Bathymetry	Geology	Seabed habitats	Chemistry	Biology	Physics	Human activities
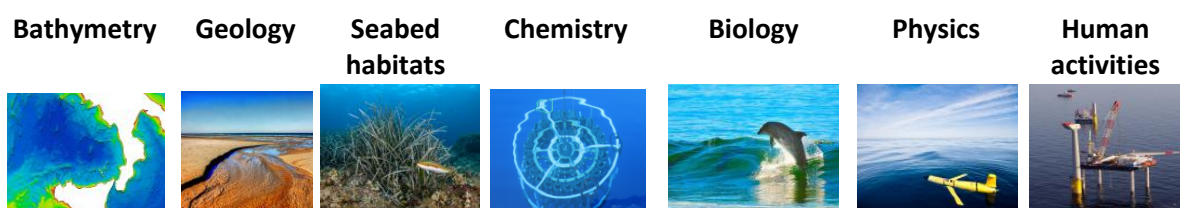
Figure 1 – The 7 discipline-based themes of marine data from EMODnet

For each of these themes, EMODnet has created a gateway to a range of data archives managed by local, national, regional and international organisations. Through these gateways, users have access to standardized observations, data quality indicators and processed data products, such as basin-scale maps. These data products are free to access and use.

EMODnet is part of the Green Paper – **Marine Knowledge 2020: from seabed mapping to ocean forecasting** Outcome of Public Consultation[42] Brussels, 11.11.2013 SWD(2013) 463 final produced by the European Commission.

The NAUTILOS project is expected to collect validate and process a huge amount of heterogeneous data that needs dedicated tools and services to favour integration and interoperability. Whenever possible the developed data management infrastructure, tools and services will allow a data flow towards existing infrastructures and integrators globally accepted and used by the ocean observing community. Data sets acquired during the project through sensors and in-situ observation systems will be made readily and freely available for these infrastructures and for the wider international scientific ocean science community and other stakeholders in this field.

Therefore, communities and data infrastructures can include EMODnet and the other infrastructures mentioned below, such as EuroGOOS, CMEMS etc. whereby the NAUTILOS data management will implement a private cloud for the project that will be used to host and disseminate data, which is going to be connected to the EU blue infrastructures.

The EMODnet Data Ingestion system would represent the entry point that activates the re-distribution into EMODnet Physics. In parallel data are also delivered to National Oceanographic Data Centers that are working under the IOC to host and make available research data and made available to Copernicus Marine Environmental Monitoring Service INS-TAC.

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[40] https://unesdoc.unesco.org/ark:/48223/pf0000232586
[41] https://www.emodnet.eu/en
[42] https://ec.europa.eu/maritimeaffairs/sites/maritimeaffairs/files/swd-2013-463_en.pdf

EuroGOOS - European Global Ocean Observing System

EuroGOOS[43] is the European component of the Global Ocean Observing System[44] of the Intergovernmental Oceanographic Commission of UNESCO (IOC GOOS[45]). EuroGOOS Secretariat is located in Brussels, serving 44 members[46] and supporting five regional systems in Europe:

EuroGOOS - 5 regional systems in Europe	NAUTILOS link
• Arctic ROOS[47]	Direct link
• Baltic ROOS, BOOS[48]	Direct link
• North-West Shelf ROOS, NOOS[49]	Direct link
• Ireland-Biscay-Iberia ROOS, IBI-ROOS[50]	Direct link
• Mediterranean ROOS, MONGOOS[51]	Direct link

Table 4 – Comparison of the EuroGOOS regional systems and links to NAUTILOS

EuroGOOS identifies priorities, enhances cooperation and promotes the benefits of operational oceanography to ensure sustained observations are made in Europe's seas underpinning a suite of fit-for-purpose products and services for marine and maritime end-users.

The following working groups are currently active in EuroGOOS:

EuroGOOS - 5 working groups	NAUTILOS link
• Coastal Working Group[52]	Possible link to explore
• Data Management, Exchange and Quality Working Group[53]	Direct link
• Science Advisory Working Group[54]	Possible link to explore
• Technology Plan Working Group[55]	Possible link to explore
• Ocean Literacy Network[56]	Possible link to explore

Table 5 – Comparison of the EuroGOOS working groups and links to NAUTILOS

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[43] https://eurogoos.eu/
[44] http://www.goosocean.org/
[45] https://ioc.unesco.org/our-work/global-ocean-observing-system-goos
[46] http://eurogoos.eu/about-eurogoos/list-of-eurogoos-member-agencies-and-contact-persons/
[47] http://eurogoos.eu/roos/arctic-roos/
[48] http://eurogoos.eu/roos/baltic-operational-oceanographic-system-boos/
[49] http://eurogoos.eu/roos/north-west-european-shelf-operational-oceanographic-system-noos/
[50] http://eurogoos.eu/roos/ireland-biscay-iberia-regional-operational-oceanographic-system-ibiroos/
[51] http://eurogoos.eu/roos/mediterranean-operational-network-global-ocean-observing-system-mongoos/
[52] http://eurogoos.eu/coastal-wg/
[53] http://eurogoos.eu/increasing-eurogoos-awareness/working-groups/data-management-exchange-quality-working-group-data-meq/
[54] http://eurogoos.eu/increasing-eurogoos-awareness/working-groups/science-advisory-working-group-sawg/
[55] http://eurogoos.eu/increasing-eurogoos-awareness/working-groups/technology-plan-working-group-tpwg/
[56] http://eurogoos.eu/ocean-literacy/

The following Task Teams are currently coordinated by EuroGOOS:

EuroGOOS - 7 task teams	NAUTILOS link
• FerryBox[57]	Direct link
• Tide gauges[58]	Direct link
• Gliders[59]	Direct link
• HF radars[60]	Direct link
• Argo floats (Euro-Argo)[61]	Direct link
• Fixed platforms[62]	Direct link
• Animal-borne instruments[63]	Direct link

Table 6 - Comparison of the EuroGOOS task teams and links to NAUTILOS

Task Teams are important operational components of the EOOS[64] framework setting out a vision and coordination mechanisms for a truly integrated ocean observing in Europe, for the benefit of society, science and innovation. Task Team members exchange open source tools, collaborate in areas of common interest, and jointly make European data available to the EuroGOOS ROOS[65] regional data portals, which in turn are feeding data to EMODnet and Copernicus Marine Service, CMEMS.

EU Green Deal

The European Green Deal[66] is our plan to **make the EU's economy sustainable.**

The European Green Deal provides an action plan[67] to:
- boost the efficient use of resources by moving to a clean, circular economy – *also goal of NAUTILOS for the oceans and seas*
- restore biodiversity and cut pollution – *also goal of NAUTILOS for the oceans and seas*

The EU aims to be climate neutral in 2050. We proposed a European Climate Law[68]to turn this political commitment into a legal obligation. Reaching this target will require action by all sectors of our economy, including
- investing in environmentally friendly technologies
- supporting industry to innovate
- rolling out cleaner, cheaper and healthier forms of private and public transport
- decarbonising the energy sector

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[57] http://eurogoos.eu/ferrybox-task-team/
[58] http://eurogoos.eu/tide-gauge-task-team/
[59] http://eurogoos.eu/gliders-task-team/
[60] http://eurogoos.eu/high-frequency-radar-task-team/
[61] http://eurogoos.eu/euro-argo/
[62] http://eurogoos.eu/emso-task-team/
[63] http://eurogoos.eu/animal-borne-instruments/
[64] http://eurogoos.eu/eoos/
[65] http://eurogoos.eu/regional-operational-oceanographic-systems/
[66] https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en
[67] https://ec.europa.eu/info/files/annex-roadmap-and-key-actions_en
[68] https://ec.europa.eu/info/files/commission-proposal-regulation-european-climate-law_en

- ensuring buildings are more energy efficient
- working with international partners to improve global environmental standards

The EU will also provide financial support and technical assistance to help those that are most affected by the move towards the green economy. This is called the Just Transition Mechanism[69]. It will help mobilise at least €100 billion over the period 2021-2027 in the most affected regions.

Digital Twin of the Ocean (DTO)
As part of the Green Deal a number of calls[70] have been launched to address the DTO, the Digital Twin of the Ocean, and much effort has been sought to link and harmonise diverse sources, platforms and frameworks to support a DTO as shown by the presentation at EOOS, the "Ocean Observation and Digital Twins of the Ocean"[71]. Also, Mercator Ocean International[72], is currently working on an initiative, along with a consortium of European institutions, to bring this innovation to life[73]. The NAUTILOS project will therefore seek to contribute to increase the possible data captured and available at reduced life-cycle cost for contributing to the DTO and improve the reliability and quantity of data underpinning the modelling of the oceans.

The Copernicus Marine Environmental Monitoring Service – CMEMS
The Copernicus Marine Environmental Monitoring Service[74] (CMEMS) provides free, regular and systematic authoritative information on the state of the Blue (physical), White (sea ice) and Green (biogeochemical) ocean, on a global and regional scale. It is funded by the European Commission (EC) and implemented by Mercator Ocean International. It is designed to increase global ocean knowledge and boost the Blue Economy across all maritime sectors[75] by providing free-of-charge state-of-the-art ocean data and information.

CMEMS delivers marine data from three sources: on site (in situ) sensors, satellite and numerical models and distributes marine data[76] from numerical models of the Global Ocean and European Seas including data assimilation methods applying a data-driven constraint on the model results. Such numerical modelling uses as many observed data as possible from in situ or satellite sources and represents interactions of the ocean with sea ice, the atmosphere and the marine biogeochemistry using state-of-the-art parameterizations and algorithms. CMEMS is enabled by the broader Copernicus Programme[77] which is the European Union's Earth Observation Programme, looking at our planet and its environment for the ultimate benefit of all European and global citizens.

Copernicus and the link with the DTO[78]
The numerical models are prototypes of Digital Twins of the Ocean, aiming at resolving all the temporal and geographical scales, their mutual interactions and impacts.

Therefore, the NAUTILOS project will coordinate efforts to actively contribute to all these initiatives in a cohesive manner with data and technologies to enable a more cost effective, reliable and data-rich future for understanding better our marine ecosystems.

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[69] https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal/actions-being-taken-eu/just-transition-mechanism_en
[70] https://ec.europa.eu/info/sites/info/files/research_and_innovation/green_deal/gdc_stakeholder_engagement_topic_09-3_digital_ocean.pdf
[71] http://www.eoos-ocean.eu/download/EOOS_Technology_Forum_Martin_Visbeck.pdf
[72] https://www.mercator-ocean.fr/en/
[73] https://www.mercator-ocean.fr/en/digital-twin-ocean/
[74] https://marine.copernicus.eu/
[75] https://marine.copernicus.eu/markets/
[76] https://resources.marine.copernicus.eu/?option=com_csw&task=results
[77] https://www.copernicus.eu/en
[78] https://marine.copernicus.eu/news/ocean-and-its-digital-twin-whats-copernicus-marine

EU Horizon Europe

Horizon Europe is the follow-on research and innovation framework for the period 2021-2027 to the Horizon 2020 framework under which NAUTILOS was approved. Therefore, there is some overlap in terms of the years in which the NAUTILOS project will be performing activities and the new Horizon Europe framework programme.

Missions:
Horizon Europe will incorporate research and innovation missions[79] to increase the effectiveness of funding by pursuing clearly defined targets. Five mission areas have been identified, each with a dedicated mission board and assembly. The board and assembly helped specify, design and implement the specific missions which will launch under Horizon Europe in 2021.

1. Adaptation to climate change including societal transformation
2. Cancer
3. Climate-neutral and smart cities
4. **Healthy oceans, seas, coastal and inland waters**[80] - *indicates top priority in 2021-2027*
5. Soil health and food

Therefore, the European Commission has the oceans and related areas as a very high priority for research and innovation in the next 7 years of this new framework with its position as one of the five missions in Horizon Europe. The European Commission hopes this mission concept will be a powerful tool to raise awareness among citizens of the importance of healthy oceans, seas, coastal and inland waters, and help develop solutions on a range of issues.

These include:

1. systemic solutions for the prevention, reduction, mitigation and removal of marine pollution, including plastics	Addressed in NAUTILOS
2. transition to a circular and blue economy	Supported by NAUTILOS
3. adaption to and mitigation of pollution and climate change in the ocean	Addressed by NAUTILOS
4. sustainable use and management of ocean resources	Supported by NAUTILOS
5. development of new materials including biodegradable plastic substitutes, new feed and food	
6. urban, coastal and maritime spatial planning	Supported by NAUTILOS
7. ocean governance	
8. ocean economics applied to maritime activities	Supported by NAUTILOS

Table 7 – Comparison of the Healthy oceans, seas, coastal and inland waters Mission Issues and links to NAUTILOS

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[79] https://ec.europa.eu/info/horizon-europe/missions-horizon-europe_en
[80] https://ec.europa.eu/info/horizon-europe/missions-horizon-europe/healthy-oceans-seas-coastal-and-inland-waters_en

Already as part of this Mission concept approach the « Mission Board on Healthy Oceans, Seas, Coastal and Inland Waters »[81] has setup the « Mission Starfish 2030: Restore our Ocean and Waters ».

Mission Starfish 2030: Restore our Ocean and Waters
The Mission Board on **Healthy Oceans, Seas, Coastal and Inland Waters** proposes a Mission Starfish 2030: Restore our Ocean and Waters by 2030[82]. Inspired by the shape of the starfish, the Mission has five overarching objectives for 2030:

(i) filling the knowledge and emotional gap,	Addressed by NAUTILOS
(ii) regenerating marine and freshwater ecosystems,	Supported by NAUTILOS
(iii) zero pollution,	Addressed by NAUTILOS
(iv) decarbonising our ocean, and waters,	Supported by NAUTILOS
(v) revamping governance.	

Table 8 – Comparison of the Mission Starfish 2030 objectives and links to NAUTILOS

The Mission Board states that these five objectives are mutually supportive and taken together, the Mission Starfish 2030 will enable the restoration of the water cycle as a whole. For each of the five objectives, a set of ambitious, concrete and measurable targets has been defined. They specifically address the actors, activities, tools and systems that all need to be called upon to reach each objective. These targets are considered the indispensable components of a holistic approach to systemic change.

C. INTERNATIONAL STRATEGIES FOR THE OCEAN

As well as NAUTILOS fitting within the European context, there is also an imperative to contribute within the international context as also desired by the EC when launching the Call topic that the NAUTILOS consortium responded with the intention to follow through on this ideal. An ideal that is also an imperative given the vastness of the oceans which do not exist isolated from each other. The occurrences around the world, as demonstrated by plastic pollution drifting thousands of kms around the globe and affecting marine life, mean true international co-operation must be a common priority.

i. International ocean governance

As already indicated in the BG07 call topic description the International Ocean Governance is an area to be taken into consideration and is also addressed in the EC joint communication Brussels, 10.11.2016 JOIN(2016) 49 final "**International Ocean Governance: an agenda for the future of our oceans** {SWD(2016) 352 final}"[83] that includes a number of concrete Actions (up to 14) for the EU contribution to improve international coordination.

Specifically, "Action 14 - International ocean research, innovation and science partnerships" is a clear intention to cooperate with partners around the globe for the common good on marine life and the health of the planet.

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[81] https://ec.europa.eu/transparency/regexpert/index.cfm?do=groupDetail.groupDetail&groupID=3666
[82] https://ec.europa.eu/info/publications/mission-starfish-2030-restore-our-ocean-and-waters_en
[83] https://ec.europa.eu/maritimeaffairs/sites/maritimeaffairs/files/join-2016-49_en.pdf

As part of this international community, the entities with which NAUTILOS can most engage with are the GOOS – the Global Ocean Observing System, the OceanOPS initiative and the Animal Borne Ocean Sensors (AniBOS) organization that are further described below:

ii. The Global Ocean Observing System – GOOS

Figure 2 – The GOOS logo

The Global Ocean Observing System (GOOS) provides countries and end-users with critical information on physical, chemical, and biological essential ocean variables, aimed at delivery for climate, operational services, and ocean health.

The GOOS mission is to lead the ocean observing community and create the partnerships to grow an integrated, responsive and sustained observing system.

GOOS is co-sponsored by the IOC, the World Meteorological Organization (WMO), the United Nations Environment Programme (UNEP) and the International Science Council (ISC).

The GOOS governance model is divided in three tiers:
1. A multinational Steering Committee to provide oversight,
2. Scientific Expert Panels[84] to guide system requirements,
    - Physics and Climate[85]
    - Biogeochemistry[86]
    - Biology and Ecosystems[87]
3. Observation Coordination Groups (OCG) that implement global unified network execution.

The GOOS Project Office facilitates the collaboration between these different governance bodies.

GOOS Regional Alliances (GRAs)
GRAs are coalitions of nations and/or institutions which share GOOS principles and goals, but are mostly concerned with local priorities and organized around regional seas or coastal environments. Thirteen GRAs represent different regions of the globe, emphasizing regional priorities, differing by need, resources and culture.

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[84] https://www.goosocean.org/index.php?option=com_content&view=article&id=11&Itemid=111
[85] https://www.goosocean.org/index.php?option=com_content&view=article&id=124&Itemid=281
[86] https://www.goosocean.org/index.php?option=com_content&view=article&id=80&Itemid=275
[87] https://www.goosocean.org/index.php?option=com_content&view=article&id=79&Itemid=273
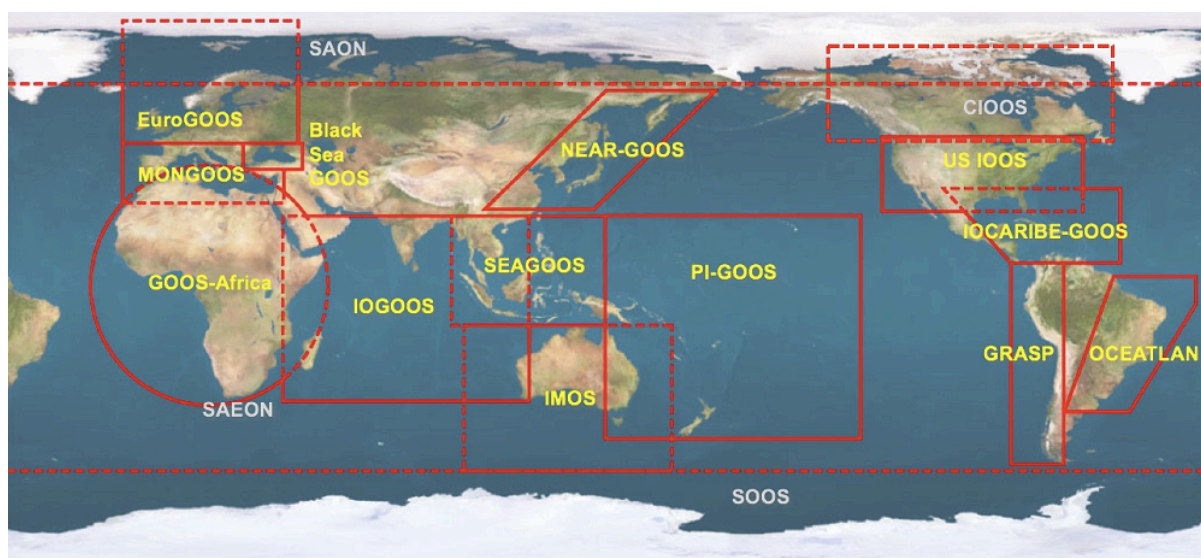
Figure 3 – Map of the GOOS Regional Alliances (GRAs)

Black Sea GOOS[88]| EuroGOOS[89]| GOOS Africa[90]| GRASP[91]| IOCARIBE-GOOS[92] | IMOS[93]| IOGOOS[94]| MONGOOS[95]| NEAR-GOOS[96]| OCEATLAN[97]| PI-GOOS[98]| SEAGOOS[99] | U.S. IOOS[100]| SOOS[101]| SAON[102]

The Expert Team on Operational Ocean Forecast Systems (ETOOFS)[103] creates guidance to improve capacity, quality and interoperability of ocean forecast products to supports climate, operational maritime services, biodiversity and blue economy. Ocean forecasting systems and products are used for maritime ship routing, coastal harbor planning and management, search and rescue, oil spill response and management, and other coastal disaster risk reduction activities.

The Observations Coordination Group (OCG)[104] is charged to review, advise on, and coordinate across the global ocean observing networks to strengthen the effective implementation of a global ocean observing system (GOOS). The vision for OCG is to contribute towards a fit-for-purpose, integrated, and coherent ocean observing system that supports:
1. a rapidly expanding set of weather, climate, marine and ocean services targeting stakeholders across the globe;
2. a vibrant international research community developing knowledge and solutions for the next decade.

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[88] https://www.goosocean.org/index.php?option=com_content&view=article&id=38&Itemid=138
[89] https://www.goosocean.org/index.php?option=com_content&view=article&id=31&Itemid=131
[90] https://www.goosocean.org/index.php?option=com_content&view=article&id=43&Itemid=143
[91] https://www.goosocean.org/index.php?option=com_content&view=article&id=47&Itemid=147
[92] https://www.goosocean.org/index.php?option=com_content&view=article&id=42&Itemid=142
[93] https://www.goosocean.org/index.php?option=com_content&view=article&id=48&Itemid=148
[94] https://www.goosocean.org/index.php?option=com_content&view=article&id=41&Itemid=141
[95] https://www.goosocean.org/index.php?option=com_content&view=article&id=37&Itemid=137
[96] https://www.goosocean.org/index.php?option=com_content&view=article&id=39&Itemid=139
[97] https://www.goosocean.org/index.php?option=com_content&view=article&id=46&Itemid=146
[98] https://www.goosocean.org/index.php?option=com_content&view=article&id=40&Itemid=140
[99] https://www.goosocean.org/index.php?option=com_content&view=article&id=45&Itemid=145
[100] https://www.goosocean.org/index.php?option=com_content&view=article&id=44&Itemid=144
[101] http://www.soos.aq/
[102] http://www.arcticobserving.org/
[103] https://www.goosocean.org/index.php?option=com_oe&task=viewGroupRecord&groupID=198
[104] https://www.goosocean.org/index.php?option=com_content&view=article&id=32&Itemid=130

iii. OceanOPS - Joint Centre for Oceanography and Marine Meteorology In Situ Observations Programmes Support
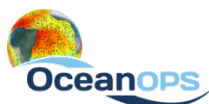
Figure 4 – The OceanOPS logo

A key element is advancing exchange of international data and metadata and system-wide monitoring capabilities through OceanOPS[105] (previously JCOMMOPS):

1. Argo dashboard – *link to NAUTILOS*
2. DBCP dashboard
3. OceanSITES
4. SOT dashboard
5. GO-SHIP dashboard
6. GLOSS dashboard
7. OceanGliders dashboard – *link to NAUTILOS*
8. AtlantOS dashboard
9. AniBOS to be incorporated – recently endorsed in GOOS – *link to NAUTILOS*

Figure 5 – The OceanOPS contributing initiatives

The OceanOPS has recently published its 5-year strategic plan (2021-2025)[106], developed with a diverse set of supporters and stakeholders.

The OceanOPS Vision
To be the international hub and centre of excellence that provides vital services in monitoring, coordinating, and integrating data and metadata, across an expanding network of global oceanographic and marine meteorological observing communities.

The OceanOPS Mission Statement
To monitor and report on the status of the global ocean observing system and networks, to use its central role to support efficient observing system operations, to ensure the transmission and timely exchange of high quality metadata, and to assist free and unrestricted data delivery to users across, operational services, climate and ocean health.

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[105] http://ocean-ops.org/
[106] http://www.ocean-ops.org/strategy

The OceanOPS Goals and Objectives

1. Monitoring for the improvement of global ocean observing system performance
   - **Objective 1.1 Develop analysis tools and metrics for all OCG networks.**
   - Objective 1.2 Analyze networks trends and report to the different stakeholders
   - Objective 1.3 Implement and report "system level" metrics for monitoring the adequacy of the system versus requirements and applications
2. Lead metadata standardization and integration across the global ocean observing networks
   - **Objective 2.1 Set and disseminate the standards and best practices for metadata harmonization across the OCG networks.**
   - Objective 2.2 Develop the web services required for machine-to-machine metadata exchange and access.
   - **Objective 2.3 Provide a harmonized and high-quality standard of metadata across all OCG networks**.
   - Objective 2.4 Assist users on data access and available data services
   - **Objective 2.5 Connect OceanOPS services with IOC and WMO international data systems**
3. Support and enhance the operations of the global ocean observing system
   - **Objective 3.1 Encourage and support the planning of observing networks implementation to enable synergies and opportunities**.
   - Objective 3.2 Develop partnerships and pilot projects to facilitate deployments/retrieval of instruments, including with civil society and industry.
   - **Objective 3.3 Promote Standards and Best Practices on instruments (installation, deployment, recovery, metadata, exclusive economic zones issues, etc.)**
   - Objective 3.4 Maintain appropriate (web-based) services to facilitate routine platform operations, including in areas under national jurisdiction.
4. Enable new data streams & networks
   - Objective 4.1 Provide basic services to emerging networks, and systems operating at the boundary of global networks under the guidance of the OCG.
   - **Objective 4.2 Pilot supporting third-party projects (civil society/industry) to help augment networks and Member States implementation.**
5. Shape OceanOPS infrastructure for the future
   - **Objective 5.1 Develop agreements with OCG networks, emerging networks and other end-users for the system to set boundaries and expectations for OceanOPS.**
   - Objective 5.2 Strengthen infrastructure in host country, workforce, and budget towards sustainability.
   - Objective 5.3 Evolve the business model, team structure, and associated funding approaches towards integration, simplification, and robustness.
   - **Objective 5.4 Enhance communications to foster community understanding and engagement**.

(Objectives in **BOLD** most relevant to NAUTILOS)

The NAUTILOS project with the links to the AniBOS and Argo initiatives has already a possible formal link with the OceanOPS initiative and can work to contribute to the OceanOPS strategy at the same time as fulfilling the NAUTILOS strategy due to many common goals and objectives.

iv. Animal Borne Ocean Sensors (AniBOS)

The NAUTILOS project has a strong link with the **Animal Borne Ocean Sensors (AniBOS)[107]** organisation via **CNRS-CEBC** (the Centre d'Etudes Biologiques de Chizé) based in Villiers en Bois is a Joint Research Unit between **CNRS** and the University of La Rochelle. **CNRS-CEBC** has a large experience in integrating oceanographic sensors into tags deployed on deep diving animals to monitor oceanographic conditions. Since 2004, **CEBC** lead the National Observatory System **MEMO** to sample temperature, salinity and chlorophyll-a profiles using seals. This data is quality controlled and freely distributed through the MEOP portal, **Marine Mammals Exploring the Oceans Pole to Pole (MEOP)[108]**.

Figure 6 – The AniBOS logo

In parallel, other NAUTILOS partners, **CEiiA** and **IMAR** have been actively involved in producing and deploying non-invasive animal tagging systems on marine life such as sharks and manta-rays that require specially developed towed tags within which can be incorporated a number of different sensors including cameras for video footage for example. Through NAUTILOS, the impetus for **CEiiA** and **IMAR** to become involved with **AniBOS** and the wider international community has been strengthened through the knowledge and partnership with **CNRS-CEBC** in a dedicated work package to look for synergies in the different tagging systems and sensors to be deployed.

The **AniBOS** organisation is relatively new and has arisen from a concerted worldwide effort to bring the data from tagged animals to international organisations, such as **GOOS**, and enhanced global databases with normally unreachable data via conventional means[109]. This is still a journey on the international stage and in coordination with the longer established initiatives at European level, particularly **EuroGOOS** and in its Task Team, the **EuroGOOS Animal-Borne Instruments (ABI)[110]**, as alluded to above in this document.

The **EuroGOOS ABI Task Team** is a network of organizations deploying little instruments on seals and other marine mammals. These instruments provide salinity and temperature profiles as well as behavioural data about the animals and their sensitivity to global and regional-scale climate variability. The **EuroGOOS ABI Task Team** was approved by the **EuroGOOS** 2016 General Assembly. The Task Team chair is Lars Boehme of the University of St Andrews, UK, and the Marine Alliance for Science and Technology for Scotland (**MASTS**)[111].

The **EuroGOOS ABI Task Team** acts as the European component in the global ABI community, MEOP, and the **USA Animal Tracking Network**[112]. The **ABI Task Team** is developed as a framework for sharing success stories and difficulties, to contribute to improving administrative procedures and regulations, and promoting and strengthening scientific synergies and cooperation. As all the **EuroGOOS** operational task teams, the **ABI Task Team** will play an important role in identifying research gaps, delivering common standards and promoting synergy, towards an integrated **European Ocean Observing System (EOOS)**[113].

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[107] http://anibos.com/
[108] http://www.meop.net/
[109] https://cdn.ioos.noaa.gov/media/2020/11/AniBOS-Slides-for-WMO-Data-Conference-Theme-3.pdf
[110] https://eurogoos.eu/animal-borne-instruments/
[111] https://www.masts.ac.uk/
[112] http://oceantrackingnetwork.org/
[113] http://eurogoos.eu/eoos/

d. NAUTILOS Strategy Statement:

The following section will focus on the specific NAUTILOS strategy statement, keeping in mind the context explored earlier in this document, which will be formed of the 4 components:
1. NAUTILOS Strategic Intent
2. NAUTILOS Mission Statement
3. NAUTILOS Vision
4. NAUTILOS Goals and Objectives

i. NAUTILOS Strategic Intent

The NAUTILOS project (**N**ew **A**pproach to **U**nderwater **T**echnologies for **I**nnovative, **L**ow-cost **O**cean ob**S**ervation) intends to develop, test and demonstrate innovative, low life-cycle cost, sensing and sampling technologies for chemical, biological and deep ocean variables to enable improved spatial resolution, temporal regularity and length of data collection than previously possible at European scale.

In parallel, the NAUTILOS project intends to foster strong collaboration, data and knowledge sharing between consortium members and stakeholders within the European community and around the globe to help democratise marine environmental monitoring and incentivize the protection of this valuable resource.

ii. NAUTILOS Mission Statement

The NAUTILOS project's mission is to fill in the gaps of marine observation and modelling with newly developed, low life-cycle cost, innovative sensing and sampling technologies that can observe chemical, biological and deep ocean variables to better characterize the marine environment. The development of project activities will be in close collaboration with the sharing of data and knowledge between all stakeholders at European and worldwide scale to ensure the maximum use of synergies and impact of the project outcomes. The newly developed and demonstrated technologies with associated tools and services will be sought to be made available to help democratize the monitoring of the marine environment and allow much improved spatial resolution, temporal regularity and length of data collection at European scale and replication around the world.

iii. NAUTILOS Vision

The NAUTILOS project's vision is to enable the democratization of improved data-rich characterizations of marine life and incentivize the sustainable growth of the blue economy.

iv. NAUTILOS Goals and Objectives

The above mentioned NAUTILOS strategic intent and mission statement are expected to be fulfilled by achieving the following Specific Objectives (SO) listed below. Each SO is listed with a number of indicators that underpin each SO, designed to be clear, measurable, realistic and achievable within the context of the NAUTILOS project's objectives:

SO1: Develop and demonstrate improved observing systems in coastal and shelf-sea environments

SO	Objective's indicators	Target
1.1	Number of sensors & samplers developed for coastal and shelf sea environments	13
1.2	Number of field demonstrations at coastal and shelf-sea sites carried out	4

SO2: Develop and demonstrate improved observing systems in the open ocean and deep-sea environments

SO	Objective's indicators	Target
2.1	Number of deep-sea capable (>2000 m water depth rated) sensors developed and demonstrated	4
2.2	Number of field demonstrations at deep-water sites (>200m water depth) carried out	3

SO3: Develop and demonstrate improved observing systems for anthropogenic debris (i.e. macro-, micro-, nano-plastics)

SO	Objective's indicators	Target
3.1	Number of cost-effective, portable micro and nano-plastics sensing and sampling technologies developed and demonstrated	3
3.2	Number of field demonstrations carried out for micro- and nano-plastics detection	3

SO4: Develop and demonstrate improved observing systems in commercial operations, i.e. fishing vessels, aquaculture facilities, ships of opportunity

SO	Objective's indicators	Target
4.1	Number of sensors and samplers developed and demonstrated on vessels of opportunity and commercial facilities	5
4.2	Number of field demonstrations carried out with vessels of opportunity and commercial facilities	3

SO5: Develop and demonstrate improved observing systems that utilise animal-borne instruments

SO	Objective's indicators	Target
5.1	Number of sensing devices (oxygen sensors) demonstrated as part of animal-borne instrument campaigns	1
5.2	Number of deployments in the oceans at regions of interest on a variety of animals for a richer dataset than currently available	60
5.3	Amount of data retrieved from the animals and to feed into NAUTILOS data and modelling activities, inserted into the MEOP initiative and sharing with the wider community	1 TB

SO6: Quantitatively assess the potential improvements on ocean simulation, ocean forecasting and remote sensing derived from NAUTILOS developments

SO	Objective's indicators	Target
6.1	Number of physical and biogeochemical model implementations benefiting from new sensors and observing strategies emerging from NAUTILOS	5
6.2	Number of marine plastic pollution model implementations benefiting from new sensors and observing strategies emerging from NAUTILOS	2
6.3	Amount of data transferred to external repositories (i.e. data integrators)	80% of collected data
6.4	Qualified data vs uncontrolled data (note: some data may be confidential and unreleasable)	50%
6.5	Publicly accessible data vs total produced data (note: some data might be available after an embargo period to allow scientific production)	80%

SO7: Appropriately collate, process, and archive all primary environmental data generated during NAUTILOS to ensure that it is maximally Findable, Accessible, Interoperable, and Reusable.

SO	Objective's indicators	Target
7.1	Amount of data transferred to external repositories (i.e. data integrators)	80% of collected data
7.2	Qualified data vs uncontrolled data (note: some data may be confidential and unreleasable)	50%

SO8: Promote and enable the widespread adoption of the NAUTILOS developments to the widest possible range of users and stakeholders (UN legislators to citizen scientists)

SO	Objective's indicators	Target
8.1	Number of citizen science campaigns carried out	5
8.2	Number of capacity building activities carried out	2
8.3	Policy-related initiatives carried out	4

SO9: Promote and develop a broad range of collaborations and contributions to international, regional, and national fora concerned with the sustainable management of marine resources and the protection of marine biodiversity with a specific focus on the European Strategy for Plastics in a Circular Economy (ESPCE)

SO	Objective's indicators	Target
9.1	Number of collaborations targeted within the timeframe of the project	> 30
9.2	Number of collaborations in relation to ESPCE targeted within the timeframe of the project	> 20
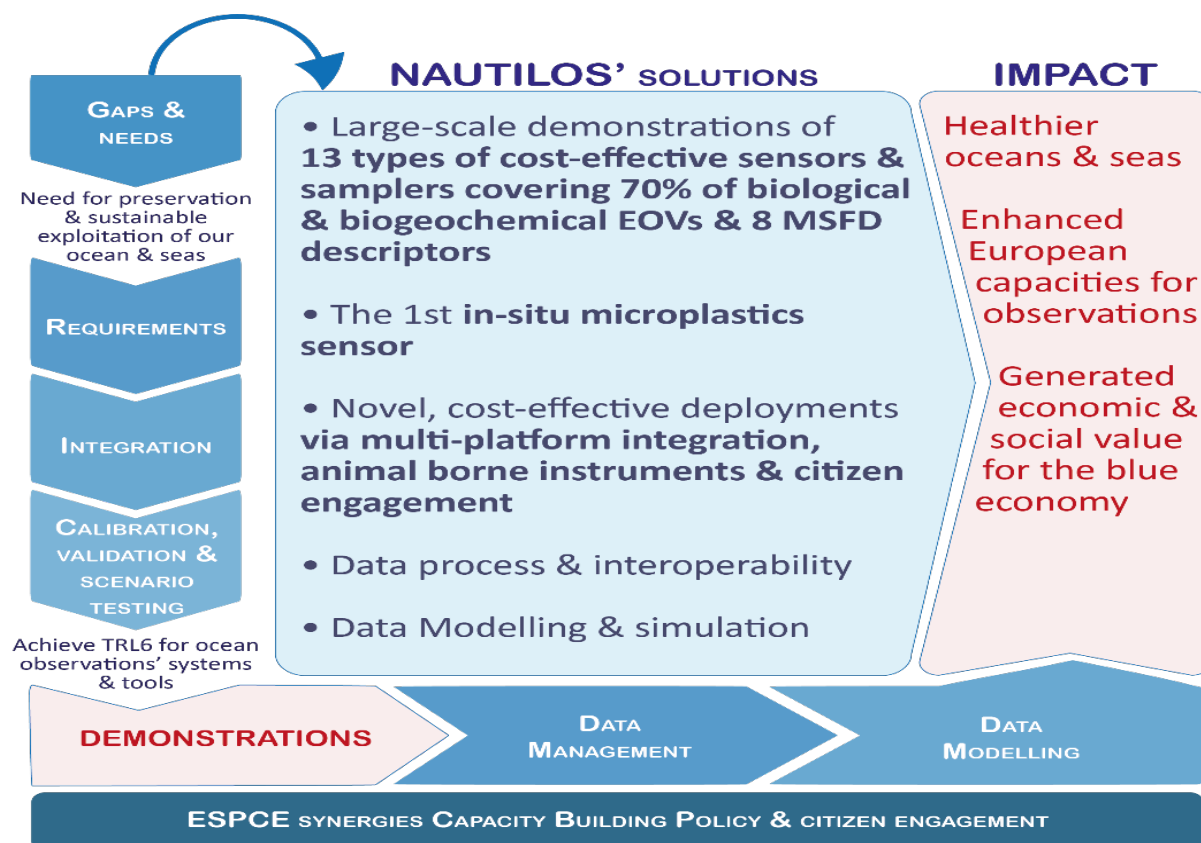
Figure 7 – Schematic Diagram of the key elements of the NAUTILOS project

E. EXPLOITATION OF RESULTS

The exploitation of results can be a very complex and sensitive process to get right during a large collaborative project such as NAUTILOS. Key to the success is each beneficiary being aware of who they are collaborating with and the specific activities that they share. A standard framework is in place via the Grant Agreement and Consortium Agreements, as explained further in the IPR Management Strategy below, that gives a common and stable legal basis for the beneficiaries to work within. In addition to this there are two first steps to follow below, which are characterisation of the beneficiaries and identification of the Key Exploitable Results (KERs). The first allows the beneficiaries to be more aware of the other partners in the consortium and the balance that exists to achieve the project's objectives. The second is an ongoing process for the beneficiaries to work upon in the next months and years of the project to adequately plan and adjust their perspectives of the activities to be performed. The consortium governing bodies, the General Assembly and the Technology & Innovation Board (TIB) will develop these plans in close collaboration with all beneficiaries in commercial confidence to protect possible Intellectual Property as well as individual commercial strategies.

i. Characterisation of Beneficiaries

As part of the analysis for the optimal way to exploit results, a characterization of the individual beneficiaries of the project will help to adjust strategies according to their nature as well as their specific activities in the project. This will also help the beneficiaries themselves in the consortium to understand the viewpoint and constraints that may face their partners in the project activities.

Table shown below of all the NAUTILOS Consortium members.

No.	Name	Short name	Country	Type (proposal designation)
1	CONSIGLIO NAZIONALE DELLE RICERCHE	01 - CNR	Italy	Public research body
2	HELLENIC CENTRE FOR MARINE RESEARCH	02 - HCMR	Greece	Non-profit public research body
3	NORSK INSTITUTT FOR VANNFORSKNING	03 - NIVA	Norway	Research body
4	SUOMEN YMPARISTOKESKUS	04 - SYKE	Finland	Non-profit public research body
5	INSTITUT FRANCAIS DE RECHERCHE POUR L'EXPLOITATION DE LA MER	05 - IFREMER	France	Non-profit public research body
6	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS	06 - CNRS	France	Non-profit public research body
7	ETT SPA	07 - ETT	Italy	SME
8	EDGELAB SRL	08 - EDGELAB	Italy	SME
9	UNIVERSIDADE DO ALGARVE	09 - UALG	Portugal	Non-profit public HEI
10	NKE INSTRUMENTATION SARL	10 - NKE	France	SME
11	AQUATEC GROUP LIMITED	11 - AQUATEC	United Kingdom	SME
12	SUBCTECH GMBH	12 - SCT	Germany	SME
13	CEIIA - CENTRO DE ENGENHARIA E DESENVOLVIMENTO (ASSOCIACAO)	13 - CEIIA	Portugal	Non-profit research body
13a	CoLab +Atlantic	13a CoLAB	Portugal	Non-profit research body
14	HAUTE ECOLE SPECIALISEE DE SUISSE OCCIDENTALE	14 - HES-SO	Switzerland	Non-profit public research body and HEI
15	CSEM CENTRE SUISSE D'ELECTRONIQUE ET DE MICROTECHNIQUE SA - RECHERCHE ET DEVELOPPEMENT	15 - CSEM	Switzerland	Non-profit research body
16	UNIVERZA V LJUBLJANI	16 - UL-FE	Slovenia	Non-profit public research body and HEI
17	FUNDACAO EUROCEAN	17 - EUROCEAN	Portugal	Non-profit foundation
18	DEUTSCHES FORSCHUNGSZENTRUM FUR KUNSTLICHE INTELLIGENZ GMBH	18 - DFKI	Germany	Non-profit research body
19	UNIVERSITA DELLA CALABRIA	19 - DIAM	Italy	Non-profit public HEI
20	IMAR - INSTITUTO DO MAR	20 - IMAR	Portugal	Non-profit research body
21	EVROPROJECT OOD	21 - EP	Bulgaria	SME

Note: due to Linked third Party the total number of entities is 22.
Table 9 – List of NAUTILOS Consortium Members

To better understand the breakdown and distribution of the different entities of the consortium a new table, shown below, which groups the entities by country and type of entity gives a clearer view of the consortium.

Table showing characterisation of NAUTILOS consortium members is shown below.

No.	Country	Public (9 entities)				Private (13 entities)				TOTAL
		Public Research Body	Non-profit public research body	Non-profit public research body and HEI	Non-profit public HEI	Non-profit foundation	Non-profit research body	Research body	SME	
1	Italy	1- CNR			19- DIAM				7- ETT 8- EDGELAB	4
2	Greece		2- HCMR							1
3	Norway							3- NIVA		1
4	Finland		4- SYKE							1
5	France		5- IFREMER 6- CNRS						10- NKE	3
6	Portugal				9- UALG	17- EUR OCEAN	13- CEiiA 13a COLAB 20- IMAR			5
7	United Kingdom								11- AQUATEC	1
8	Germany						18- DFKI		12- SCT	2
9	Switzerland			14- HES-SO			15- CSEM			2
10	Slovenia			16- UL-FE						1
11	Bulgaria								21- EP	1
	TOTAL	1	4	2	2	1	5	1	6	22

Table 10 – Division of NAUTILOS Members by Type and Country

There is a diverse number of countries represented in the consortium, 11 countries in total and no more than 4 members of the consortium per country (Colab +Atlantic is a Third Party to CEiiA). Also, there is a complementary distribution in terms of the types of entities involved, private or public sector, which can help ensure a diverse and effective dissemination and exploitation of results.

ii. Key Exploitable Results (KER)

Exploitation of results – Key Exploitable Results (KER)
The various paths for exploitation are covered by the NAUTILOS project's Key Exploitable Results (KERs) which covers diverse areas such as research (including open access), commercial outcomes, public/private investment avenues, as well as the social, environmental contexts, and policymaking, standards setting, skills and educational training and outreach where relevant, as shown in the table below.

Who: Key Target Audience	Why: Objective	How: Activities, Channels and Tools		Exploitation of the results - Key Exploitable Results (KER):
		During the project	After the project	
1. EU and International networks	Ensuring compliance and alignment to gaps and needs	EAB representation, Stakeholder meetings, NAUTILOS initial, mid and final conferences	Project website	Setting standards
2. Policy and decision makers	Represent NAUTILOS interests to decision makers, bridge the science-policy gap	EAB representation, 3 policy briefs, policy roundtable, newsletter (policy section), 3 presentations elaborated for European institutions, NAUTILOS initial, mid and final conferences, Social Media, Website, Project videos	Project website, project videos	Policymaking considering results provided by NAUTILOS
3. Blue economy commercial and industrial sector operators	Inform about NAUTILOS marine technological developments relevant to their sector, primarily aquaculture & fisheries	EAB representation, Stakeholder brokerage meetings, NAUTILOS initial, mid and final conferences, External events participation (i.e. congresses, trade shows), Social media, Website	Social Media, Project website, project videos, Joint proposal applications	Commercial, investment – application of the marine technology developed and demonstrated in NAUTILOS

4. European observation commercial sector (technology providers)	Inform and collaborate for NAUTILOS marine technological, modelling and data developments and products	EAB representation, Stakeholder brokerage meetings, NAUTILOS initial, mid and final conferences, External events participation (i.e. congresses, trade shows), Social media, Website, Project videos	Social Media, Project website, project videos, Joint proposal applications	Commercial, investment
5. The fundamental and applied marine research community	Be informed and feed information into the project	EAB representation, Journal publications, Synergies building activities, Capacity building dissemination campaign and learning labs, Stakeholder meetings, NAUTILOS conferences, External events participation (i.e. conferences, symposia, workshops)	E-learning material, joint proposal applications, project website	Skills and education training, open access research, environmental application of the marine technology developed
6. Related projects in the areas of marine and earth observation	Ensure synergies, differentiation, building on previous projects and increasing project's impact	Synergies building and clustering activities, Articles, NAUTILOS conferences, External events participation	Clustering initiatives, Joint proposal applications, Project website	Research (incl. open access)
7. NGOs and citizen scientists	Bridge the society-science gap, recruit citizen scientists for the campaigns	ocean literacy and public engagement campaign, citizen science trainings and campaigns, Online campaign	Project website, project videos, e-learning material	Social impact, citizen science, more efficient use of resources
8. The general public	Inform and engage the public, convert it to citizen scientists	ocean literacy and public engagement campaign, citizen science campaigns	Project website, Social media, project videos, e-learning material	Social impact, citizen science, greater empathy and support for marine causes by the public
9. The media	Inform the media of NAUTILOS	Press releases, website, newsletter	Project website	Greater empathy, availability, informed coverage of marine causes by the media

Table 11 – Key Exploitable Results (KERs) of NAUTILOS

These KERs will be developed and monitored during the NAUTILOS project's activities whilst at the same time an instrumentation roadmap (10 years) will be created in parallel to both an environmental and socio-economic impact assessments that will be performed to ensure a more holistic approach. All this will take into account the varied prototypes that will be developed in NAUTILOS, such as:

1. fluorometric Sensors/dissolved oxygen,
2. dissolved oxygen and fluorescence sensors
3. downward looking multi/hyperspectral sensors, laser induced fluorescence sensors & cameras
4. passive broadband acoustic recording sensor for noise monitoring,
5. passive acoustic event recorder,
6. active acoustic profiling sensor,
7. sampler for phytoplankton and other suspended matter,
8. carbonate system/ocean acidification sensors,
9. silicate electrochemical sensor,
10. sampler for nano-plastics and micro-plastics,
11. low-cost micro-plastic sensor,
12. deep ocean conductivity, temperature and depth (CTD) sensor,
13. deep ocean low-level radioactivity sensor.

Associated services, tools and data transfer will be considered as well as improved models and techniques that can further extend the useful exploitation of NAUTILOS activities.

In the table below the KERs are linked to the various activities, Work Packages (WP), in the NAUTILOS project. As the project progresses, this will be monitored and updated for the final version of the Exploitation Strategy with concrete results, once necessary intellectual property rights are secured.

Who: Key Target Audience	Key Exploitable Results (KER):	Links to NAUTILOS Work Breakdown Structure (WBS)
1. EU and International networks	Setting standards	External Advisory Board and Data Management Plan in **WP1**, Technical Requirements in **WP2**, Data Management in **WP8**, Outreach, Communication and Dissemination in **WP10**, Exploitation and Impact in **WP11**, Synergies with European Strategy for Plastics in a Circular Economy in **WP12**, Ethics Requirements in **WP13**
2. Policy and decision makers	Policymaking considering results provided by NAUTILOS	External Advisory Board and Data Management Plan in **WP1**, Technical Requirements in **WP2**, Data Management in **WP8**, Outreach, Communication and Dissemination in **WP10**, Exploitation and Impact in **WP11**, Synergies with European Strategy for Plastics in a Circular Economy in **WP12**, Ethics Requirements in **WP13**
3. Blue economy commercial and industrial sector operators	Commercial, investment – application of the marine technology developed and demonstrated in NAUTILOS	Sensors in **WP3** & **WP4**, Platforms in **WP5**, Laboratories & Testing in **WP6**, Fisheries, Aquaculture, Observatories and Platforms of Opportunity in **WP7**, Data Modelling & Sharing in **WP9**, Outreach, Communication and Dissemination in **WP10**, Exploitation and Impact in **WP11**, Synergies with European Strategy for Plastics in a Circular Economy in **WP12**
4. European observation commercial sector (technology providers)	Commercial, investment	Sensors in **WP3** & **WP4**, Platforms in **WP5**, Laboratories & Testing in **WP6**, Fisheries, Aquaculture, Observatories and Platforms of Opportunity in **WP7**, Data Modelling & Sharing in **WP9**, Outreach, Communication and Dissemination in **WP10**, Exploitation and Impact in **WP11**, Synergies with European Strategy for Plastics in a Circular Economy in **WP12**
5. The fundamental and applied marine research community	Skills and education training, open access research, environmental application of the marine technology developed	Data Modelling & Sharing in **WP9**, Outreach, Communication and Dissemination in **WP10**, Exploitation and Impact in **WP11**, Synergies with European Strategy for Plastics in a Circular Economy in **WP12**
6. Related projects in the areas of marine and earth observation	Research (incl. open access)	Sensors in **WP3** & **WP4**, Platforms in **WP5**, Laboratories & Testing in **WP6**, Fisheries, Aquaculture, Observatories and Platforms of Opportunity in **WP7**, Data Modelling & Sharing in **WP9**, Outreach, Communication and Dissemination in **WP10**, Exploitation and Impact in **WP11**, Synergies with European Strategy for Plastics in a Circular Economy in **WP12**
7. NGOs and citizen scientists	Social impact, citizen science, more efficient use of resources	Data Modelling & Sharing in **WP9**, Outreach, Communication and Dissemination in **WP10**, Synergies with European Strategy for Plastics in a Circular Economy in **WP12**
8. The general public	Social impact, citizen science, greater empathy and support for marine causes by the public	Data Modelling & Sharing in **WP9**, Outreach, Communication and Dissemination in **WP10**, Synergies with European Strategy for Plastics in a Circular Economy in **WP12**
9. The media	Greater empathy, availability and informed coverage of marine causes by the media	Data Modelling & Sharing in **WP9**, Outreach, Communication and Dissemination in **WP10**, Synergies with European Strategy for Plastics in a Circular Economy in **WP12**

Table 12 – Key Exploitable Results (KERs) of NAUTILOS linked to NAUTILOS WBS

2. IPR Management Strategy

A. Introduction

The main contractual documents that govern the Intellectual Property Rights (IPR) for the NAUTILOS project are:

1. NAUTILOS Grant Agreement (GA)
2. NAUTILOS Consortium Agreement (CA)

With these governing legal documents in mind, the main considerations to be considered for the NAUTILOS IPR management strategy are described below.

i. Definitions

To establish common ground and understanding, the fundamental definitions of the relevant legal contracts and the types of eligible Intellectual Property (IP) are further described below. The general structure of Horizon 2020 projects, illustrated below,
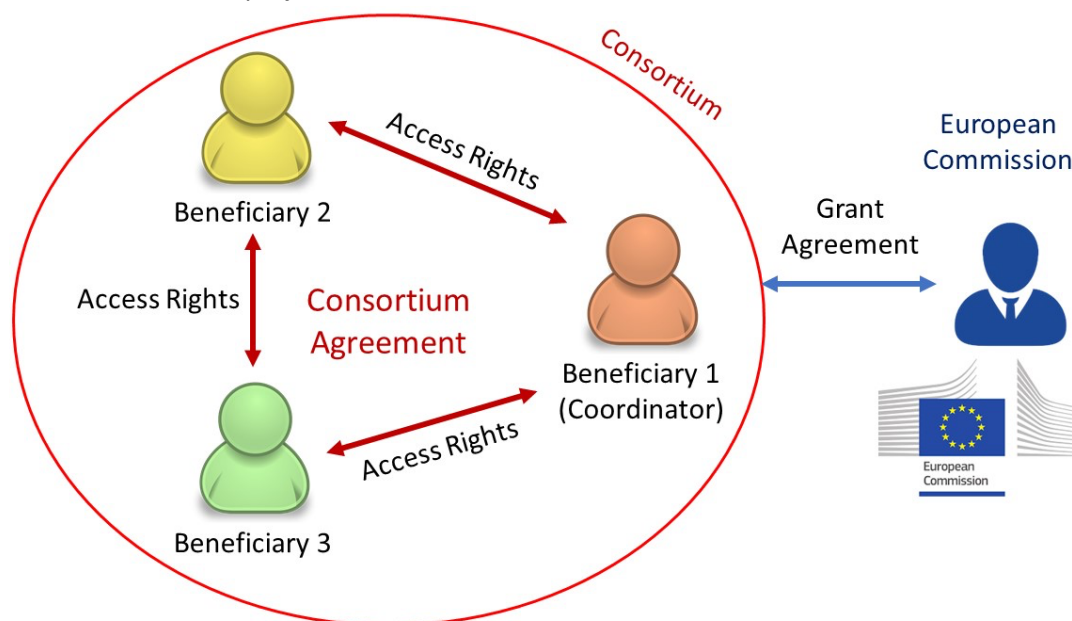
Figure 8 – Schematic Diagram of General Structure of Horizon 2020 Projects

Grant Agreement (GA): This is a contract concluded between the European Union, EU, (represented by the European Commission (EC) or one of its agencies, for NAUTILOS is REA) and the beneficiaries (represented by the coordinator) whose project has been successfully awarded a grant. Under this agreement, the beneficiaries commit themselves to a set of rights and obligations in return for the funding granted by the EC.

Beneficiaries: The legal entities, other than the EU, who are parties to the GA and form the consortium to carry out the awarded project. After the signing of the GA, applicants become the beneficiaries of the grant, and they are bound by the entirety of terms and conditions as written in the GA.

Consortium Agreement (CA)*:* This is an internal agreement that beneficiaries conclude among themselves for the implementation of the project. The agreement allows the beneficiaries to determine the detailed administrative and management provisions (i.e. division of roles regarding the rights and responsibilities) necessary to carry out their project. This agreement cannot contradict or

negate the provisions established by the GA or the Rules for Participation (RfP) set by the EC. **The EU is not party to the CA**.

Coordinator: The coordinator is the beneficiary who is the central contact point for the EC and represents the consortium before the EC. The GA is signed between the EU and the coordinator and subsequently acceded to by the other beneficiaries.

The following tables list the Intellectual Protection (IP) terms and definitions relevant to NAUTILOS:

IP Asset	Intellectual Property
Inventions	Patents, Trade Secrets
Aesthetic characteristics of industrial designs	Designs
Distinctive signs, Brands	Trademarks
Know-how	Trade Secrets
Computer programs	Copyright, Patents
Literary, Artistic and Scientific works	Copyright

Table 13 – List of possible means of IP protection for different IP assets

IPR	Protection - Description
Patent	Any invention, product or process that offers a new way of doing something or provides a new solution to a problem
Utility Model	Minor inventions or minor improvements of existing products
Design	Ornamental or aesthetic aspects of a product
Trademark	Any sign capable of distinguishing your goods or services from your competitors'
Copyright	Literary and artistic works: music, books, paintings, computer programmes, databases, etc.
Trade Secrets	Any information that is not generally known, confers a competitive edge and is subject to reasonable efforts to maintain its secrecy
Geographical Indications & Appellations of Origin	Signs used on goods with a specific geographical origin and which possess qualities, reputation or characteristics mainly related to that place of origin

Table 14 – Description of the possible means of IP protection for different IP assets

Classification of Knowledge/ IP	Description
Background	According to the AGA, background is defined as "any data, know-how or information – whatever its form or nature (tangible or intangible), including any rights such as intellectual property rights – that: (a) is held by the beneficiaries before they acceded to the [Grant] Agreement & (b) is needed to implement the action or exploit the results".
Foreground	Foreground knowledge/IP -- the IP rights created by the parties within the framework of the agreement.
Sideground	Sideground knowledge/IP -- refers to IP rights created by the parties during the period of the agreement, but outside the framework of the arrangement.
Postground	Postground knowledge/IP -- refers to IP rights created by the parties after the project ends.
Access Rights	Conditions of access to the knowledge/IP that is accorded to other parties within the framework of the agreement. In Horizon 2020, there are two types of access rights for beneficiaries: (1) access rights to background, and (2) access rights to results.

Table 15 – Description of the types of IP terms used in the NAUTILOS GA & CA

B. H2020 PROJECT RULES

The terms and conditions relevant for IPR and the Exploitation of Results are described:

1. Within the GA:
   a. Section 3 – Rights and Obligations Related to Background and Results.
   b. Section 4 – Article 36 – Confidentiality & Article 37 – Security-related Obligations.
2. Within the CA:
   a. Section 8 – Results
   b. Section 9 – Access Rights
   c. Attachment 1: Background included

The main points to be considered are described below.

i. Outline of Provisions, Access Rights and IPR Protections

The following table gives an overview of the general conditions concerning the granting of access rights as established in the GA and CA:

Purpose	Access to Background	Access to Results
Implementation of the project	Royalty-free, unless otherwise agreed by participants before their accession to the Grant Agreement	Royalty-free
Exploitation of project results	Subject to agreement, access rights shall be granted under fair and reasonable conditions (which can be royalty-free)	

Table 16 – Overview of Access Rights conditions according to NAUTILOS GA and CA

In NAUTILOS, the beneficiaries have identified and agreed on what constitutes the background for their projects in writing by inserting this in the Attachment 1 of the CA.

The access rights to background must be requested in writing ("request for access"). This request can be made, for example, in an e-mail, within the CA where the terms and conditions mentioned are set. Access rights to background for the other beneficiaries can be granted for the implementation stage of the project and for the exploitation stage, since exploitation of results may also require access to other beneficiaries' background.

NAUTILOS project beneficiaries must give access on a **royalty-free basis** to each other's background, where it is necessary in order to carry out their tasks during the project.

NAUTILOS project beneficiaries must give each other access to their background which is necessary for the exploitation of their own results under **fair and reasonable conditions**.

It should be noted that fair and reasonable conditions also include royalty-free conditions.

Requests for access may be made up to one year following the end of the project term, unless otherwise agreed.

ii. Outline of Open Access Provisions

Open access (OA) can be defined as the practice of **providing on-line access to scientific information that is free of charge to the reader**. In the context of R&D, open access typically focuses on access to '*scientific information*' or '*research results*', which refers to two main categories:

- Peer-reviewed scientific research articles
  - (primarily published in academic journals)
- Research data
  - (data underlying publications, curated data and/or raw data)

Within the Grant Agreement, in Section 3, "Article 29 – Dissemination of Results – Open Access – Visibility of EU Funding" the terms and conditions for OA in the NAUTILOS project are covered.

There is an obligation to disseminate results as per any other H2020 project, but similarly it should be noted that this does not change the obligation to protect results in Section 3, Article 27, the confidentiality obligations in Section 4, Article 36, the security obligations in Article 37 or the obligations to protect personal data in Article 39, all of which still apply.

Therefore, it must be noted that open access does not affect the decision to exploit research results commercially, e.g. through patenting. The decision on whether to publish through open access must come after the more general decision on whether to publish directly or to first seek protection. This is illustrated in the chart below, which shows open access to scientific publication and research data in the wider context of dissemination and exploitation.
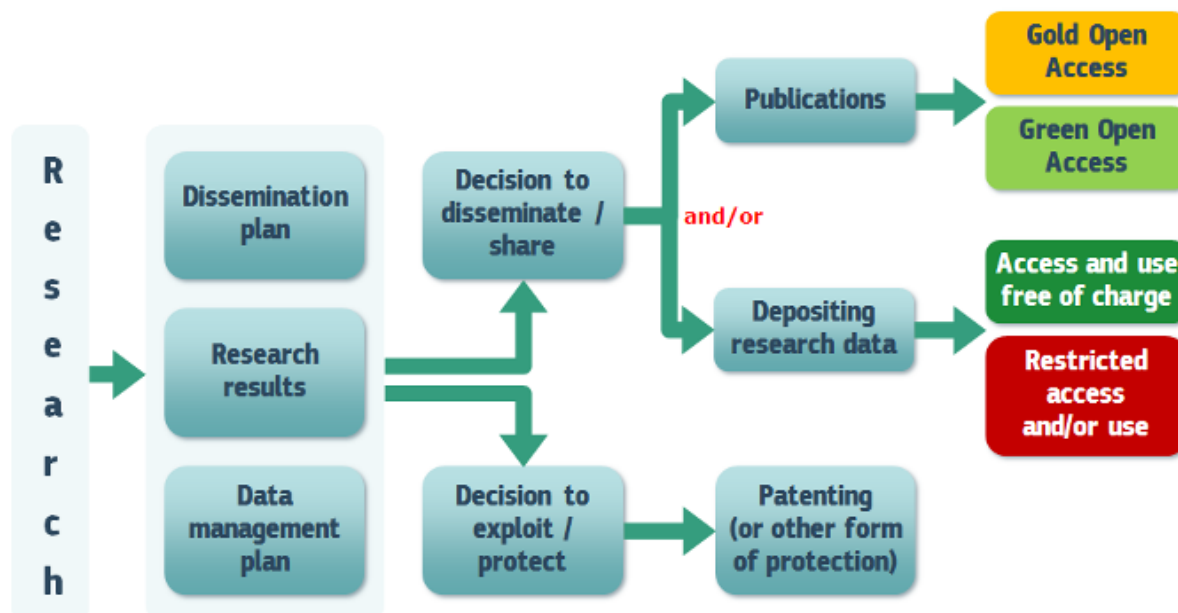

Figure 9 – Flow-chart of the options for disseminating and exploiting results

This flow-chart is particularly useful within the NAUTILOS project due to the mix of public and private entities with both commercial and scientific research purposes and goals. The table summarises very basically the different perspectives on the exploitation or dissemination of research and innovation:

	Research Organisations (RO)	Industry
Type of Research	Basic research	Applied research
Interest	Scientific application	Commercial application
Aim	Improve science	Improve company value
Outcome	Open	Protected
Dissemination	Publishing	Patenting, trade secrets or other

Table 17 – Traditional view of the types of research and interest by ROs and Industry

This table is prone to be interpreted differently in now more modern times where the lines are more often blurred and

For the publications route the NAUTILOS partners will need to choose between a choice of:

1. **Self-archiving / 'green' OA**: beneficiaries can deposit the final peer-reviewed manuscript in a repository of their choice. They must ensure open access to the publication within at most 6 months (12 months for publications in the social sciences and humanities).

2. **Open access publishing / 'gold' OA**: researchers can also publish in open access journals, or in hybrid journals that both sell subscriptions and offer the option of making individual articles openly accessible

To support the decision-making process, it should be noted that "Article processing charges" are eligible for reimbursement during the duration of the project. The costs of 'gold' open access publications incurred once a project is completed cannot be refunded from that project's budget. However, a mechanism has been piloted to address the issue of open access publication charges incurred once a grant agreement with the Commission has expired. This pilot project, funded under the OpenAIRE2020 project[114], supported open access publications arising from completed FP7 projects.

OpenAIRE

OpenAIRE[115] has grown through a series of project phases funded by the European Commission: from the DRIVER projects to link Europe's repository infrastructure, to the first OpenAIRE project aimed to assist the EC in implementing its initial pilot for Open Access (OA) to publications, and, through several further phases which have extended and consolidated the OpenAIRE mission to implement Open Science policies. OpenAIRE's ambitious plan will enable the social and technical links to make Open Science a reality in Europe and beyond. It will address, on one hand, key aspects and challenges of the currently transforming scholarly communication landscape and, on the other, will actively seek and promote new solutions in the realm of new technologies and expanding amounts of information that better suit the needs of Researchers, Innovators, the Public and Funding bodies.

OpenAIRE is the recommended entry point for researchers to determine what repository to choose, offering support services for researchers, such as the National Open Access Desks. Other useful listings of repositories are:

- Registry of Open Access Repositories (ROAR)[116]
- Directory of Open Access Repositories (OpenDOAR)[117]

OpenAIRE fits into the wider strategy of the European Open Science Cloud[118] (EOSC).

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[114] https://www.openaire.eu/openaire-project
[115] https://www.openaire.eu/
[116] http://roar.eprints.org/
[117] https://v2.sherpa.ac.uk/opendoar/
[118] https://www.openaire.eu/openaire-and-eosc

The European Open Science Cloud (EOSC)
The European Open Science Cloud (EOSC)[119], aims to be a trusted virtual environment to enable data driven science across boundaries and disciplines and is currently being developed by the EU. Implementing Open Science policies, workflows and infrastructures throughout all corners of the European research sphere are critical to make EOSC work. EOSC is a co-created set of services and interests for many of its users, with an open governance structure and a space for bottom-up innovation and a long-term pillar of the Digital Single Market[120].

Open Research Europe
Open Research Europe[121] is a scholarly publishing platform available to Horizon 2020 and Horizon Europe beneficiaries. It comes at no cost to them, has a rigorous and open peer review process, and the open access model enables everyone to access the results[122].

Horizon Results Booster
The Horizon Results Booster initiative[123] are specialised services to maximise the impact of H2020 funded projects including project's Portfolio Dissemination & Exploitation Strategy, in the case a project has clearly identified key exploitation results.

The above avenues for dissemination and exploitation of results are to be considered and chosen on a case-by-case basis with the other aspects of the NAUTILOS project in mind. Such aspects include for example the links to be made with CMEMS and EMODnet for the exchange of data as well as the commercial aspects to be considered. A summary table gives an idea of the differences between publishing (mainly scientific in nature) and patenting (mainly commercial in nature).

Comparison	Publishing	Patenting
Applicability	For knowledge sharing purposes	For commercially exploitable technology
Rights Granted	Copyright	Exclusive rights
Procedure	No	Yes
Costs	Low to none	High
Use of Technology	Everyone	Only the patent owner, unless licensed
Technology Protection	No, only the article	Yes, on the patent claims
Financial Gain	Likely, but only on the paper publication	Yes
Technology Disclosure	Immediately	After 18 months

Table 18 – Differences between Publishing and Patenting

Whilst the obvious action for commercial applications would be to patent an invention or commercially exploitable technology, there are, however, other strategies that could be followed:
1. Defensive publications
2. Secrecy

Defensive Publication
When an invention is publicly disclosed, it immediately enters into the state of the art. Consequently, no one else will be able to patent the same invention as the novelty requirement will be impeded. Therefore, if a technology does not meet the patentability criteria or is not worth the price of a patent,

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119 https://eosc-portal.eu/
120 https://ec.europa.eu/commission/priorities/digital-single-market_en
121 https://open-research-europe.ec.europa.eu/
122 https://op.europa.eu/en/publication-detail/-/publication/b5a8eee0-1811-11eb-b57e-01aa75ed71a1
123 https://www.horizonresultsbooster.eu/

a different strategy can be chosen, whereby the "Defensive Publication" is a cheaper alternative for scientists and research enterprises.

Secrecy
Instead of publishing or patenting, scientists and research companies may also opt to keep their technology secret, mainly for those inventions that do not qualify for patent protection or have a very short lifecycle. For example, confidentiality is very suitable for new production processes, the end products of which give no clues about the process innovation and thus cannot be easily reverse engineered.

Alternatives	Advantages	Disadvantages
Defensive Publications	—Cheap —Locks competitors out —Free dissemination of knowledge —Freedom to operate	—Discloses inventions to competitors —No exclusivity —Less market impact
Open Access	—Freely accessible for users —Free dissemination of knowledge —No management required	—Costs for authors —Less impact in terms of paper visibility
Secrecy	—Cheap —No invention disclosure —Damages relief	—High level management —No protection against reverse engineering —No IP infringement

Table 19 – Summary of the Advantages & Disadvantages of ways of exploiting Results

Further considerations will be developed and agreed within the Data Management Plan for NAUTILOS.

C. CONSORTIUM AGREEMENT IPR BASELINE

The NAUTILOS Beneficiaries have agreed and signed the Consortium Agreement, CA, following the DESCA model agreement[124] and choosing the relevant options in a collaborative manner.

i. Current Background and Protection

The Background listed in the NAUTILOS Consortium Agreement follows the standard template given in the DESCA model CA as shown below:

Describe Background	Specific limitations and/or conditions for implementation (Article 25.2 Grant Agreement)	Specific limitations and/or conditions for exploitation (Article 25.3 Grant Agreement)
Description of relevant Background belonging to the BENEFICIARY necessary for achieving the goals of the Project work plan, as specified in the Annex I (Description Of Action) of the GA.	State if there are any limitations for beneficiaries during the implementation phase	State if there are some limitations for beneficiaries during the exploitation phase

Table 20 – Standard Format of the Table for Declaring Background in CA

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[124] http://www.desca-agreement.eu/

Currently the CA is the document of reference and follows the general rules aligned with both the CA and GA whereby the Background to be made available

Table defining possible choices and conditions in a typical CA

Purpose	Access to Background	Access to Results
Implementation of the project	Royalty-free, unless otherwise agreed by participants before their accession to the Grant Agreement	Royalty-free
Exploitation of project results	Subject to agreement, access rights shall be granted under fair and reasonable conditions (which can be royalty-free)	

Table 21 – Definition of possible choices and conditions in a typical CA

With this in mind, an overview of the status of the Background declarations in the CA is given below.

Purpose	Access to Background	Access to Results	No Background declared
Implementation of the project	10 entities Royalty-free access to what can be specifically needed for project and within beneficiary's authority to grant access	10 entities As per CA and GA rules, access permitted when justified and via writing	11 entities To the best of their knowledge no data, know-how or information is needed for the other beneficiaries
Exploitation of project results	10 entities Access Rights subject to agreement		

Table 22 – Summary of the current choices for Access Rights in the NAUTILOS CA

The content of the Background in the signed CA is subject to be updated as the project activities progresses as necessary. All parties are committed to perform the Description of Work in the GA which will ultimately dictate the level of access rights as the project develops. The beneficiaries are bound by the terms and conditions of the CA and GA, with the completion of the GA the guarantor of EU funding to the beneficiaries, particularly in a Lump Sum Action.

ii. Overview of Current Open Source and Open Hardware licenses

Currently there are no Open source or Open Hardware licenses in discussion for implementing NAUTILOS activities. Once deeper technical activities are performed and the need for data, hardware or software sharing is better understood, the beneficiaries will endeavour to seek whatever protections or adjustments deemed necessary to the CA if required.

The project requirements will be monitored as an ongoing process via the Consortium bodies of reference in the NAUTILOS project, such as the Technology and Innovation Board (TIB) and the General Assembly. The design of the Work Breakdown Structure (WBS) should ease any potential issues of granted access to background and or joint ownership of results whereby the various phases of the development process are divided by different Work Packages (WP), for example, the sensors' development is in a separate WP to the WPs for the integration on platforms and demonstrations.
The final update of this deliverable will then be able to contain a more complete overview of such licenses if needed with the outlining application to project scope. An example table that can be updated in final version of this deliverable is shown below.

Technology Owner	Technology Name	Type of license	Work Package(s)
Name of beneficiary	*Name of technology*	*Designation of license*	*Which WPs are relevant*

Table 23 – Example Table that can be updated in the Final Version of this Deliverable

D. IP COMMERCIALISATION

Within Section 3 of the GA, the Exploitation of Results is covered in the "Article 28 – Exploitation of Results" as well as in "Article 30 – Transfer and Licensing of Results".

i. Overview of Options

Commercialisation is the process of turning products and services into a commercially viable value. Concerning Intellectual Property (IP), this term can be more specifically defined as the process of bringing IP to the market in view of future profits and business growth.
The process depends on several internal and external factors such as business objectives, type of IP as well as economic and intellectual resources. In addition, since IP can be commercialised either directly by its owner, through an assignment or by building up business partnerships, the selection of the most appropriate tool is often challenging, especially for Small and Medium-sized Enterprises (SMEs).
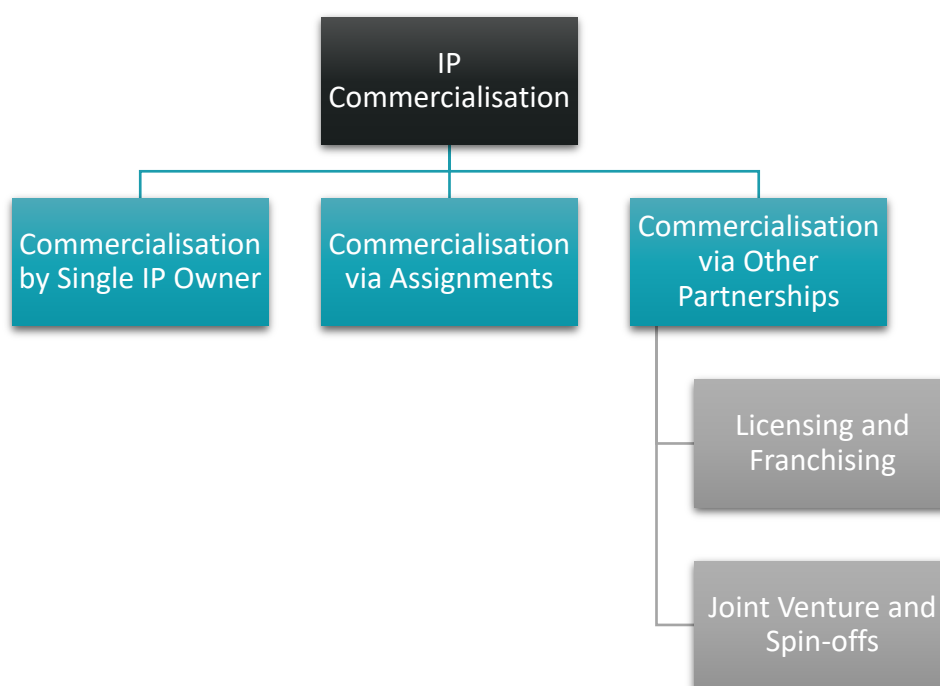
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                          ┌──────────────────┐
                          │        IP        │
                          │ Commercialisation │
                          └──────────────────┘
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┌──────────────────┐  ┌──────────────────┐  ┌──────────────────┐
│ Commercialisation │  │ Commercialisation │  │ Commercialisation │
│ by Single IP Owner│  │ via Assignments  │  │   via Other      │
│                  │  │                  │  │   Partnerships   │
└──────────────────┘  └──────────────────┘  └──────────────────┘
                                              │
                                              │   ┌──────────────────┐
                                              ├───│  Licensing and   │
                                              │   │   Franchising    │
                                              │   └──────────────────┘
                                              │   ┌──────────────────┐
                                              └───│ Joint Venture and │
                                                  │    Spin-offs     │
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Figure 10 – Hierarchy of types of possible commercialisation

Commercialisation by single IP owner
This is the simplest form of commercialisation whereby there is no dependency on other parties for the IP to be commercialised and negotiated with interested investors or clients.

Commercialisation via Assignments
An IP assignment is a transfer of ownership of an IPR, such as a patent, trademark or design, from one party (the assignor) to another party (the assignee). Consequently, the assignee becomes the new owner of the IPR.

Assignments are useful tools for commercialisation, when the owner of the IP does not have enough capabilities (financial, human resources, marketing, etc.) to market the developed intellectual asset and/or when the owner would like to realise an immediate cash flow from an IP asset, which he does not plan to exploit with its own resources.

Commercialisation via Other Partnerships

Licensing

A licence is a contract under which the holder of an intellectual property (licensor) grants permission for the use of its intellectual property to another person (licensee), within the limits set by the provisions of the contract. Hence, in business language, a licence allows the licensor to make money from its intellectual asset by charging the licensee in return for its use. A table explaining benefits of licensing for both parties is shown below.

For Licensor	For Licensee
Opportunity to reach new markets with existing products/services.	Opportunity to create new businesses.
Opportunity to enter a market with existing clientele of the licensee, which reduces risks for market failure.	Opportunity to provide licensor's already available/well established products/services to the clients, which reduces risks for market failure
No need to invest in marketing and distribution.	No need to invest on R&D.
The licensor retains ownership of the IP while receiving royalty income from it.	The licensee does not need to "purchase" the IP and use the opportunity to test market success of the licensed product/service without investing much.
Licensing is a means for turning a possible competitor into a partner	

Table 24 – Summary of the Benefits of Licensing for both Parties involved

Besides, licence agreements can also be seen as an instrument for the distribution of risks between the licensor and the licensee. Tables explaining the risks of licensing for both parties as well as the types of licence are shown below.

For Licensor	For Licensee
The licensee can become a competitor.	Licensing may create a technological/business dependence.
The licensor can lose control of the licensed product/service	The licensed IP may be challenged and the technology become obsolete.
There are difficulties to find a fair, solid licensee willing to obtain a licence.	There are difficulties to find a fair, reliable licensor willing to grant a licence.
Licensors must trust licensees as a source of revenue. In the case of a market failure, licensees may generate no revenues although there may be a minimum royalty clause in the agreement.	Payments can be too burden-some to cover and a certain amount might still need to be paid even though there is a market failure because of a minimum royalty clause in the agreement.

Table 25 – Description of the Risks of Licensing for both Parties involved

Exclusive Licence		Non-Exclusive Licence
Exclusive: only the licensee is able to use the licensed IP or technology (the licensor cannot use or license it);	Sole: the licensor agrees not to grant any additional licences but retains the right to make use of the licensed IP.	The licensee and the licensor can both use the licensed intellectual property or technology. The licensor is also allowed to negotiate further non-exclusive licences with other entities.

Table 26 – Explanation of the different types of Licensing

A table explaining the differences between assignment and licensing agreements is shown below.

Assignment	Licensing
The party "selling" the IP: Assignor The party "buying" the IP: Assignee	The party "renting out" the IP: Licensor The party "renting in" the IP: Licensee
The owner of IP changes and becomes the assignee.	The owner of IP does not change and remains the licensor.
An assignment is a permanent transfer of rights.	A licence is a temporary transfer of certain rights.

Table 27 – Summary of differences between Assignment and Licensing Agreements

Franchising

Franchising is a special type of licensing, enabling the replication of the owner's (franchisor) business concept in another location by providing continuous support and training to the recipient (franchisee). Since business concepts include the use of IP allowing the business to be run, franchising has an intrinsic connection with IP based on licensing of IPRs and Know-how.

Joint Venture

JVs are business alliances of two or more independent organisations ("venturers") to undertake a specific project or achieve a certain goal by sharing risks. IP has an important role in the creation of such collaborations, since venturers bring their own intellectual assets for the success of a JV and they should agree on their initial contributions, responsibilities and obligations within the alliance as set out in JV agreements.

Spin-offs

Spin-offs (or spin-outs) are separate legal entities created by a parent organisation (PO) to bring its IP assets into the market. It is generally an efficient solution for the parent organisations, who may not be fully capable of commercialisation of their own IP assets, such as for universities and research institutions. Spin-offs are seen as an important means of technology transfer since they are acting as an intermediary between the research environment and industries while putting research results into the commercial market with a marketable product. Moreover, through spin-offs, research organisations can focus on their main task of "research" instead of "marketing", which is the main task of commercial companies (spin-off).

Generally speaking, there are two different types of spin-offs according to their formation namely;
- Spin-off by separation
- Spin-off formed by a person external to the parent organisation (PO)

Spin-off by separation

In this type of formation, the spin-off company is formed through separation from the parent organisation's structure. The PO directly contributes to the spin-off with its financial, human and intellectual capital as the spin-off is literally "born" from the PO in order to exploit part of its intellectual assets. It is often the case that the IP assets are transferred to the spin-off company by assignment, which means that all risks and obligations are also transferred to this new legal entity.

<u>Spin-off formed by a person external to the PO</u>

A spin-off company can be formed by a person external to the PO for the exploitation of the IP asset created by the parent organisation. In this type of spin-off, as the new company is owned by an external professional, the IP assets to be exploited by the new company (spin-off) are generally transferred by licensing, to allow the PO to keep control over them. The external professionals can also be venture capitalists, who foresee a market potential in commercialisation of IP.

An evaluation by the NAUTILOS partners will be made at opportune times during the execution of the project where business plans and instrumentation roadmaps are still to be developed as the project activities progress and less uncertainty on project outcomes are achieved.

E. RISK ANALYSIS AND MITIGATION MEASURES

Consideration here for aspects such as risk analysis, mitigation measures and resolution mechanism.

i. Risk Analysis

As part of the risk analysis for the IPR management strategy, a selection of the most relevant risks identified in the NAUTILOS project are shown below and their monitoring and mitigation measures will be part of the standard management practices of the NAUTILOS Consortium. Furthermore, aspects of Liability, Access Rights, Confidentiality and Disclosure are covered by the standard Grant Agreement and Consortium Agreement terms and conditions in line with the regulations:

No.	Description of risk	WP number
2	Closing the activity of one partner leaving the consortium	WP: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13
4	Poor communication flow or disputes between partners	WP1
5	Lack of financial resources or budget insufficiency	WP: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13
7	One or more partners do not comply with the work plan, are unable to provide the required contributions or cannot deliver their tasks respecting the schedule	WP: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13
10	Software deliverable delayed: delay in software development a) for processing and transmitting data from sensors, b) to manage platforms, c) to access data and implementation of integration tool, d) to collect, inter operate and display data through web portals and e) to run OSSE simulation.	WP: 5, 6, 7, 8, 9
11	No available or not enough data to feed into the modelling	WP9
12	Lack of data availability for performing the EIA with enough specificity on the developments and planned actions	WP11
13	Weak communication and dissemination to key stakeholders	WP10
16	Timing: results are delivered too late to be fully disseminated	WP: 1, 10, 11
18	Disagreements with respect to IPR and exploitation.	WP: 1, 11
19	The relevance of the project's outcomes is lower than initially planned.	WP: 1, 10, 11, 12
21	Delays in sensor testing and demonstrations actions due to: a) limitations in personnel travel, b) access to the testing/ demonstrating research infrastructure or shipping limitations, c) vessel non-availability, d) availability of vessels of opportunity during the demonstration phase.	WP: 6, 7

Table 28 – NAUTILOS Risks most relevant to the IPR Management Strategy

Liability:

- Addressed in the GA, Chapter 4 – Rights and Obligations of the Parties;
- Addressed in the GA, Chapter 6 – Rejection of Costs, Reduction of the Grant, Recovery, Sanctions, Damages, Suspension, Termination, Force Majeure;
- Addressed in the GA, Chapters 2 – Action and 3 – Grant in terms of funding from the EU;
  - Lump sum terms and conditions of the Grant Agreement also add an extra "layer" to the dynamic for executing the NAUTILOS project given that the payment of funds is linked to the collective completion of all deliverables and milestones of each work package for that work package to be considered completed and the payment of funding to be made in full to all parties involved.
- Addressed in the CA, Section 5 - Liability towards each other;
  - In this section it is defined the type of warranties that each beneficiary can expect from each other, as well as the limitations to the contractual liability and responsibilities regarding damages. A Force Majeure clause is also included to cover exceptional cases.

Access Rights:

- Addressed in the GA, Section 3 – Rights and Obligations related to Background and Results;
  - Beneficiaries that are universities or other public research organisations must take measures to implement the principles set out in Points 1 and 2 of the Code of Practice annexed to the Commission Recommendation on the management of intellectual property in knowledge transfer activities[125].
- Addressed in the CA, Section 9 – Access Rights governs in harmony with the GA;
- The listing of the Background in the Annex I to the CA has defined the Access Rights to specific data, know-how, information and equipment and facilities of the beneficiaries.

Confidentiality:

- Addressed within the GA in Section 4, Article 36 – Confidentiality;
- Addressed within the CA in Section 10 – Non-disclosure of information.

Disclosure:

- This is linked to the Confidentiality clauses mentioned in the GA and CA;
- Expected to be also addressed in the Data Management Plan (DMP), with the support of the Data Controller, in alignment with CA and GA. Aspects such as the process to release information once all internal checks on data integrity and possible requirements for IP protection are discussed and agreed between relevant parties.

Generally speaking, the beneficiaries are all participating in good-faith with the common goal to meet the NAUTILOS objectives in a mutually beneficial and collaborative manner.

ii. Mitigation Measures

All the risks that have been identified in the GA have mitigating actions and a due process to monitor and maintain the risk register as standard practice in managing such complex collaborative

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[125] Commission Recommendation C(2008) 1329 of 10.4.2008 on the management of intellectual property in knowledge transfer activities and the Code of Practice for universities and other public research institutions attached to this recommendation.

programmes. The identified risks relevant to IPR management above are an intrinsic part of this process and do all possible mitigation measures will be known and agreed between partners and acted upon as necessary through the programme management and Consortium bodies, such as TIB and General Assembly.

The mechanisms and payments of the pre-financing has already been made within the CA and acts as a mitigating factor that enables each party to initiate activities as soon as possible with the most confidence to implement the Action.

A number of clauses in the CA cover the number of eventualities such as Force Majeure but also the possibilities of beneficiaries leaving or the transferring results to others that help give a framework within which the Consortium members can mitigate occurrences during the project.

It can be generally accepted that each party is responsible for its own activities, equipment and human resources whilst all care will be made when working in collaborative activities where an evaluation and risk assessment will need to be made on a case by case basis. Depending on the possible risks and liabilities identified the appropriate measures will be made such as the need for the insurance or additional support from experts to reduce risk and liability for all involved.

iii. Resolution mechanism

The NAUTILOS partners will resort to the governance structure established by the GA and CA in order to resolve any issues that cannot be resolved at the individual level. In all cases the onus is to reach a mutually respectable agreement between the parties involved and avoid any animosity or break in trust which is essential in collaborative projects.

The Governance Structure comprises of the General Assembly as the ultimate decision-making body of the Consortium where one member from each party is represented. The General Assembly is supported by the Technical and Innovation Board which supervises the technical implementation of the Action as described in the GA and can serve a first filter for issues that may arise before reaching the General Assembly.

Appendix 1: References and Related Documents

ID	Reference or Related Document	Source or Link/Location
1	Submitted NAUTILOS proposal in response to the BG-07 Call topic	*NAUTILOS ownCloud < Confidential document >*
2	NAUTILOS Grant Agreement No. 101000825	*NAUTILOS ownCloud < Confidential document >*
3	NAUTILOS Consortium Agreement	*NAUTILOS ownCloud < Confidential document >*