JUNE 2013
DG FISHERIES AND MARITIME AFFAIRS

Study to support Impact Assessment of Marine Knowledge 2020

EXECUTIVE SUMMARY

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Executive summary - introduction

The improvement of marine knowledge is one of the main objectives of the European integrated maritime policy. In 2010, the European Commission in its Communication on Marine Knowledge 2020 presented a strategy on improving marine knowledge as a "key element to achieve smart growth in the European Union in line with the 'Europe 2020' strategy". The objectives of the Marine Knowledge 2020 strategy are to reduce operational costs related to data use, increase competition and innovation from marine knowledge and to reduce uncertainty on the state of the oceans and seas.

The present study is aimed at gaining a deeper understanding of the current practices as well as opportunities and benefits of future marine knowledge sharing. The study includes seven components covering a set of 18 individual questions to be answered. The components are:

1 Marine data in the licensing process
2 Costs of data for Marine Strategy Framework Directive
3 Cost of data for offshore wind farms
4 Legal basis of Regulation or Directive
5 Innovation from marine data
6 Reductions in uncertainty
7 Options for governance of EMODNet

The study is being undertaken by COWI A/S in cooperation with Ernst & Young. COWI was the lead responsible for components 1 to 4 and 7, while Ernst & Young took lead on components 5 and 6.

Overview

The terms of reference defined 18 the specific evaluation questions which were answered based on data collection exercise involving surveys, questionnaires and interviews combined with literature review.

Table 0-1 provides a summary answers to each of the study questions.

Table 0-1 Summary of findings by each study question

	Study question	**Findings**
(1)	Do potential operators of licensed activities mentioned in point 2.2 pay for meteorological, bathymetric or geological data when preparing their application for a licence?	It seems that in about half the Member States data have to be purchased. Their costs are however relatively minor compared to overall licence costs. The costs of data in relation to Environmental Impact Assessments (EIAs) are often not known by the licence or permit applicant as the EIAs are done by external consultants and the purchasing of data is not billed separately.
(2)	Would they request more data (i.e. higher resolution in time or space) if it were substantially cheaper or easier to access?	The replies indicate that the licensees only collect the data necessary for the preparing the application so there is no indication that further data would be requested if data were either cheaper or easier to access.
(3), (4) (5)	Is the licensee obliged to hand over to public authorities the data collected or acquired in order to plan, develop or engage in the licensed activities including marine and coastal aquaculture, renewable energy, minerals extraction, oil exploration and exploitation, port harbour and marina development and pipeline and cable laying	No general answer can be given on this question. The obligation to hand over to public authorities, marine data collected or acquired in relation to licensed activities varies greatly across sectors and Member States. Of the ten countries for which information was received, in 7 there is an obligation to hand over marine data in at least some of the marine sectors. In most cases this obligation covers all phases of marine projects, i.e. siting, planning, construction and operation.
(6)	How much effort will Member States spend up to 2020 on data acquisition, management and dissemination (including enabling access to the Commission and the European Environment Agency) in meeting the requirements of the Marine Strategy Framework Directive?	For the initial MSFD assessment in the 22 coastal Member States and Croatia a total costs of EUR 45-55 million was estimated. The estimated effort up to 2020 can be estimated to be in the range of EUR 66-73 million, consisting of the costs of existing and new monitoring programmes (see questions (7) and (8))
(7)	How much of this cost is assembling existing data (i.e. data already collected, or being collected for other purposes)?	The estimate of yearly cost of assembling data from existing monitoring programmes based on an upscale of data from 9 Member States is EUR 45-52 million This could be an underestimate as it most likely do not include all relevant monitoring programmes.
(8)	How much will be spent on collecting new data (i.e. data from new monitoring and survey programmes that would not have been collected without the Marine Strategy Framework Directive needs)?	Estimate of yearly costs for new monitoring programmes: order of magnitude estimate EUR 20 million The estimate of the costs of new monitoring programmes is likely to be an underestimate as only very few Member States were able to provide an estimate. In many cases the decisions on new monitoring programmes have not yet been made and hence, it is difficult for the Member States to provide estimates.
(9)	What marine data will be required for planning, building and operating offshore wind farms in Europe up to 2020?	Based on consultation with the off shore wind sector supplemented by literature reviews and expert assessments, the different types of data are described in chapter 4.
(10)	How much will be spent collecting, purchasing, assembling and processing these data?	Using the same approach as for Question 9, the costs of data have been estimated. For an "average" offshore wind farm of 200 MW, the total data costs for planning, construction and operation could amount to EUR 19 million. With projections of new capacity in the order of 35-38 GW in the period up to 2020, total data costs for the sector could amount to EUR 3.4 - 3.7 billion. The major part of the costs, are costs for geotechnical site surveys
(11)	What legal basis could be used for a Directive or Regulation on marine knowledge that meets several objectives? Are there any examples?	Both the issues of legal basis and legal instruments have been assessed, and key aspects are presented.

	Study question	Findings
(12)	Assuming that historic and real-time data were available on parameters such as chemical pollution, non-native species, coastal erosion, storm intensity etc. what services based on these and other data: › Might reduce risks for aquaculture producers?	In total 15 case examples have been identified and assessed concerning description of problem/opportunity, the effect of additional data and the link to Knowledge 2020 and finally a description of the innovative service and an estimate of the potential economic benefits. The 15 case studies covering the four sectors demonstrate that additional marine data can promote innovation and suggest that there are significant economic benefits.
(13)	› Might enable insurance companies in coastal regions to provide a better assessment of risk?	
(14)	› Could support a longer season for coastal tourism?	
(15)	› Could help the bio-economy discover new products (pharmaceuticals, enzymes, cosmetics etc.)	
(16)	The contractor should provide three more examples of the economic benefits of reduced uncertainty in the behaviour of the sea or the state of the seabed and marine life.	In total 3 examples of reduced uncertainty have been identified and assessed. They demonstrate that there could be significant economic benefits from reduction in uncertainty of the state of the oceans and seas.
(17)	How would such an arrangement work? Are there any examples (other than EU Agencies)?	The arrangement of the work was described and different organisation options assessed including descriptions of examples of management structures.
(18)	Could it be done through the Joint Programming Initiative on Healthy Seas and Oceans? Or through the Joint Research Centre? Or through an executive agency? Or through a public-private partnership? What would be the costs and benefits in each case?	The organisational options have been assessed and the advantages and disadvantages of alternative options are presented and described.

A further summary of each study area is presented in the following sub-sections of the executive summary.

Marine data in the licencing process

The study has investigated whether licence or permit applicants pay for certain types of marine data when preparing the applications. The assessment has indicated a varied situation regarding payment for bathymetric, meteorological and hydrological data. License or permit applicants have to pay for some data but often they have to do their own data collection which is more costly.

Table 0-2 Potential payment for bathymetric, metrological and hydrological by permit or licence applicants in selected Member States

Bulgaria	Licence applicants have to pay for marine data
Denmark	Licence applicants have to pay for marine data
Cyprus	Marine data free of charge (information from the ports sector)
France	Licence applicants have to pay for marine data (information from the ports sector in La Rochelle)

Germany	Licence applicants have to pay for marine data products, but not for data sets (information only available for renewable energy and cable and pipeline laying)
Norway	Licence applicants have to pay for marine data
Romania	Marine data free of charge (unless the marine data come from research institutions/agencies)
UK	Some marine data free of charge

Source: Results of industry association's survey

A second issue in relation to permits or licences is whether there are obligations for the applicants to hand over the collected data to the relevant authority. A majority of Member States responding to a survey (ten out twelve) replied that they have obligations for licence or permit applicants to hand over data. The requirement usually does not concern commercially sensitive data. Furthermore, few Member States collect data in the INSPIRE format. Data is often made available for re-use upon request.

Table 0-3 Obligations to hand over data to public authorities by permit or licence applications

Bulgaria	Obligation to hand over data varies between sectors and phases of operations (siting, construction, operation)
Croatia	Obligation to hand over data
Cyprus	Obligation to hand over data in the aquaculture sector
Estonia	Extensive obligation to hand over data
England	No obligation to hand over data
Germany	Information only available for renewable energy and cable and pipeline laying: Obligation to hand over certain marine data
Iceland	Obligation to hand over data for all sectors
Ireland	Obligation to hand over data in aquaculture, renewable energy, minerals extraction, port, harbour and marina development and cable and pipeline laying
Latvia	Obligation to hand over data from monitoring activities for all sectors (Aquaculture n/a)
Northern Ireland	Information only available for renewable energy, mineral extraction, port, harbour and marina development and cable and pipeline laying: Obligation to hand over marine data
Norway	Obligation to hand over data (no information available for oil exploration and exploitation)
Romania	Obligation to hand over data (n/a for renewable energy and minerals extraction as there are no such offshore activities in Romania)
Scotland	No obligation to hand over data
Spain	No general obligation to hand over data

Source: Results of Member State survey

Cost of data for the Marine Strategy Framework Directive

The Marine Strategy Framework Directive (MSFD) includes a number of requirements where there is need for collection of marine data. This study has investigated the costs of data collection activities based on a questionnaire survey among the Member States.

Ten Member States have provided information and they represent a good sample of all EU coastal states (location, population, GDP level, coastline, geography).

The reported costs have therefore been adjusted using GDP levels and labour costs and scaled up for 22 coastal states using average costs. Due to the diverse geography, economic and social properties of the respondent countries this method provided the best results. The estimates that have been calculated in response to the questions in the Terms of Reference for this project are the following:

› Estimates of the efforts related to the initial assessment required by the MSFD in the 22 coastal Member States and Croatia: EUR 45-55 million.

› Estimate of yearly cost of assembling data from existing monitoring programmes: EUR 45-52 million.

› Estimate of yearly costs for new monitoring programmes: around EUR 20 million as an order of magnitude estimate.

› The estimate of the effort related to the initial assessment is the least uncertain of the estimates. Regarding existing monitoring programmes that provide data to the MSFD, Member States might have included mainly the environmental programmes. Data are typically also provided from other monitoring activities for example monitoring of fisheries. Hence, the costs of existing programmes that provides data for the MSFD are likely to be underestimated.

The estimate of the costs of new monitoring programmes is also likely to be an underestimate as only very few Member States were able to provide input on new programmes. In many cases the decisions on new monitoring programmes have not yet been made and hence, it has proven difficult for Member States to provide estimates that could support the assessment.

Cost of off shore wind farms

The study has included a comprehensive assessment of all types of data costs in relation to planning, construction and operation of off-shore wind farms

The assessment has been developed as the costs of one off-shore wind farm with a capacity of 200 MW and then up-scaled that estimate over the 35 to 38 GW of off shore wind capacity which is expected in EU by 2020.

The estimation indicates that data costs of an offshore wind farm of 200 MW are in the order of EUR 19 million and with projected new capacity to be installed in the order of 35-38 GW, the total data costs in the sector could be in the order of EUR 3.4 - 3.7 billion. The major part of the total costs, are costs for geotechnical site surveys.

The costs of the geotechnical site surveys depend very much on the conditions at the specific location and they could vary with plus/minus EUR 5 million compared to the average estimates presented here. It means that the costs for one 200 MW offshore wind farm would be in the range of EUR 14 million to EU 24 million.

Table 0-4 Estimated costs of establishing 36-39 GW wind farm capacity in Europe by 2020

	Mean cost 200 MW Wind farm €	Costs till 2020 for establishing 35-38 GW Million €
	Planning Phase	
Metocean data	740,000	130-141
Bathymetrical/geophysical/geo-technical data	1,800,000	315-342
Benthic flora and fauna data	310,000	54-59
Fish data	125,000	22-24
Birds data	550,000	96-105
Marine mammals data	370,000	65-70
Total planning phase	**3,895,000**	**682-741**
	Construction phase	
Metocean data	43,000	7.5-8
Bathymetrical/geophysical/geo-technical data	12,900,000	2,258-2,451
Benthic flora and fauna data	175,000	31-33
Fish data	70,000	12-13
Birds data	300,000	53-57
Marine mammals data	200,000	35-38
Total construction phase	**13,688,000**	**2,397-2,600**
	Operation phase	
Metocean data	66,000	12-13
Bathymetrical/geophysical data	145,000	25-28
Benthic flora and fauna data	390,000	68-74
Fish data	115,000	20-22
Birds data	700,000	123-133
Marine mammals data	285,000	50-54
Total operation phase	**1,700,000**	**298-324**
Grand total costs	**19,283,000**	**3,377-3,665**

Legal assessment

The legal assessment has included considerations of the possible legal basis for the alternative options for the Marine Knowledge 2020 initiative.

Option	Impacts (positive/negative)	Legal basis
1. A 'do nothing approach' meaning no changes to existing legislation	Increasing uneven implementation at MS level regulatory uncertainty and no reduction of costs/ continued distortion of competitive conditions/Internal Market and thus not sufficient stimulation of innovation	As before
2. Amending existing legal instrument(s)	Depends on clearer framing of options on legal measures. The assumption is that a legal initiative will lead to greater legal certainty, reduction of costs due to the economic importance of open data including reduction of competitive market hindrances as well as increased stimulation of innovation.	Changes to the existing legislative acts will have to be made within the same legal basis of the Treaty.
3. New legislation	Depends on clearer framing of options on legislative or non-legislative acts. The assumption is that it will bring about enhanced legal certainty, lowering barriers for re-use of data and thereby reducing costs.	Legal basis for horizontal measures needs to be identified and agreed, either within existing legal Treaty basis for EU maritime policy or within the legal basis for horizontal environmental measures, depending on the framing of the exact option. In the case the options will identify legislative acts according to Art 288 TFEU (Regulations, Directives or Decisions) the ordinary legislative procedure in Art 294 TFEU shall be applied. Non-legislative acts will either have to be based on the Treaties or based on secondary legislation/implementing acts based on implementing powers procedure - 'comitology'- (Art 291 TFEU) or through adoption of delegated acts through delegated power to the Commission (Art. 290 TFEU)
4. Soft law measures	May to some extent facilitate application of the rules of the PSI Directive on licensing and charging. Will however not necessarily improve the uneven implementation at MS level to the same degree as with a legal action, so regulatory uncertainty and distortion of competitive conditions may still occur at the same scale.	Legal basis can be found within existing legal basis for EU maritime policy, as before.
5. One to more combinations of the above options ("package solution").	Depends on clearer framing of options on specific package. The assumption is that combining legal amendments with soft law measures will bring together the benefits from options 3 and 4 above and thus provide enhanced legal certainty, removal of barriers for promoting re-use of data, reducing costs and stimulating innovation.	Legal basis for horizontal measures needs to be identified and agreed, either within existing legal basis for EU maritime policy or within the legal basis for horizontal environmental measures, depending on the framing of the exact option.

Innovation from marine data and benefits resulting from the reduction of uncertainty

Improved marine knowledge, whether it be through better sharing of datasets on past and present events, improved coordination of research efforts, or other types of specific phenomena, can bring potentially significant economic, social and environmental benefits.

These benefits can be realised through the creation of innovative services and encourage the growth of emerging sectors, through the mitigation of risks and negative impacts, or through a reduction in uncertainty regarding the state of the oceans and seas. The benefits are therefore expressed in a number of different manners, which include:

- Avoidance of revenue/production losses
- Increase in profitability
- Reduction in costs
- Regional economic impacts.

Firstly, a number of case examples of innovations based on marine data has been identified and developed.

Subsequently also a number of case examples of the benefit of reduced uncertainty based on improved marine data has been identified and developed.

The following methodological issues and limitation should be kept in mind regarding the presented case examples of innovation and reduced uncertainty based on marine data.

- Largely based on existing documentation and studies
- Extrapolations of specific quantitative examples based on assumptions
- Specific examples that may not reflect the entire opportunities for the sector
- Specialists, whilst providing a sanity check of desktop research, do not necessarily represent the views of the entire sector
- Challenge in isolating the particular impact of "improved marine knowledge" in the development of an innovation or sector

The two tables below summarises the findings of the identified case studies, in terms of the importance of marine knowledge/data and a demonstration or estimation of the economic benefits.[1]

[1] For currency conversion, the follow assumptions have been made: $US1 = €0.78 and £1 = €1.17.

Table 0-5 Case study examples of innovation

Title	Hypothesis	Data needs	Economic benefits
Reduced risk to aquaculture production			
Early warning device for jellyfish blooms	Limited knowledge regarding the reasons for blooms, their impacts and potential mitigation strategies. An early warning system to anticipate blooms and better understand behaviour and impacts, and minimise damage to aquaculture production.	Widespread monitoring to obtain site-specific data on jellyfish populations, including their seasonal occurrence and abundance. Need to coordinate research at a regional level, and share results of studies.	Assuming that half of the 12% mortality rate due to gill disorders[2] can be attributed to jellyfish, and that the affected species are mostly Mediterranean mussels, as well as northern rainbow trout and salmon production (€1.4 billion market in 2009)[3], **addressing jellyfish impacts could assist in avoiding losses to production of € 84 million** (1.4 billion x 6%).
Offshore aquaculture: new sea-cage design	Expansion of offshore aquaculture requires cages designed to withstand extreme conditions, protect against invasive species, and production losses (escapes) and keep maintenance costs low.	Hydrographical data to optimise cage location, data on the structure and quality of the seabed, meteorological data to predict waves, currents, and information on past extreme weather events and real time monitoring.	New cage design could lower production costs through fewer visits, and minimising risk of fish escape. A study of the "Economic Feasibility and Impact of Offshore Aquaculture" in the Gulf of Mexico[4] provides an idea of the potential of the offshore aquaculture sector through improved cage design. This study concluded that a single farm operation directly employing only seven individuals for offshore production can provide an **additional annual regional economic output (direct, indirect, and induced effects) of at least $US 9 million (€7 million) and provide additional employment for at least 262 persons**, related to processing, feed production, distribution, etc.
Understand and address ocean acidification	Ocean acidity has an impact on the ecosystem, but it is not well understood. Understanding ocean acidification, and the impact it has on shellfish will assist in predicting and minimising further negative impact on the ecosystem (global observation network).	Data on behaviour of flora and fauna to changes in acidity, comparable paleo-data (past events and impacts), time-series data, real time monitoring data. Stronger links between research and industry.	Economic costs of reduced mollusc production due to ocean acidification in the EU 15 (at the time of study) will be **at least $US 500 million (€ 375 million) in 2100 under a business-as-usual scenario**.[5] This estimation of economic impact is only based on mollusc production. But because molluscs are the basis of many other fish feeding chains, the global impact of acidification in aquaculture (capture) should be even greater.

[2] Baxter, E., Rodger, H., McAllen, R., Doyle, T. (2011), "Gill disorders in marine-farmed salmon: investigating the role of hydrozoan jellyfish", Aquacult Environ Interact, Vol. 1: 245–257, 2011

[3] Facts and Figures on the Common Fisheries Policy, 2012 edition, DG MARE

[4] Posadas, B. C., and C. J. Bridger. 2005. Economic Feasibility and Impact of Offshore Aquaculture in the Gulf of Mexico. MASGP 04---. In Bridger, C. J. (ed.). Efforts to Develop a Responsible Offshore Aquaculture Industry in the Gulf of Mexico: A Compendium of Offshore Aquaculture Consortium Research. Mississippi-Alabama Sea Grant Consortium, Ocean Springs, MS

[5] Economic Costs of Ocean Acidification: A Look into the Impacts on Shellfish Production, Daiju Narita, Katrin Rehdanz, Richard SJ Tol, 2011

Better assessment of risk for insurance companies			
Insurance discounts through improved marine safety information	Through more reliable nautical charts and maritime safety information, insurance providers may be willing to offer products with reduced premium's resulting in lower insurance costs, which is a major operating cost factor for shipping companies.	Improved quality nautical charts – including topographic data, seabed features, and navigational hazards – as well as better coverage of open seas through hydrographical surveys. Meteorological data in order to anticipate natural events and protect both hull and cargo.	Marine insurance premiums are known for their volatility, with a complex array of internal and external drivers acting. However, improved navigational technology, owing, in large part, to greater availability of marine data, has significantly reduced risks associated with this industry. As an illustration of economic benefits associated with marine data, there is an agreement between a US marine system software company and insurance provider whereby **customers whose vessels are equipped with the MICAD Marine System** (a real-time marine data collection and management system which includes information, diagnostics, satellite communication, vessel and fuel management, and permanent archival of vessel data on each individual vessel or an entire fleet) **are offered a 20% discount on insurance products**.[6]
Managing natural disaster risk in Europe's coastal regions	Costs of weather-related natural disasters have been rising and in large part due to climate change. Data is highly fragmented and of little use for climatologists and actuaries seeking to better understand and plan for the effects of climate change.	Type of data needs can vary depending on the type of analysis and the disaster likely to occur – e.g. monitoring activities in flood prone needs rain-fall data, water level telemetry stream flow and storm surge, whilst climate change modelling needs reliable time-series data on a span of climatological indicators. There is a need for metocean data that is already widely collected by industry and public authorities, as well as coastal monitoring data on phenomena such as coastal erosion and flooding.	Economic benefits of improved risk assessment can be substantial in the long run. With losses in 2011 in Europe totalling over $US 9 billion (€7 billion), strategic investments in adapting Europe's coastal regions could result in **hundreds of millions in economic benefit**. For instance, if better modelling and monitoring allowed coastal adaptations to be only slightly more effective, **losses could be reduced by millions annually**. While this estimate is crude and does not take into account more unquantifiable benefits such as the long-term health of Europe's insurance industry, it gives an idea of how small investments may make a huge impact.
Improving the certification process for offshore wind projects	In a sector evolving at such a fast pace, underwriters can be hesitant about extending certain types of coverage to innovative designs. Independent certification provides outside assurance.	While more widely available metocean data cannot replace site specific data collection, as crucial environmental parameters can vary drastically over short distances in marine environments meaning developers need a 'high resolution picture' of the specific site, it could be highly valuable at other stages of the certification process, such the conceptual design phase and elaborating an effective maintenance strategy.	Insurance has an important role in supporting investment in offshore wind projects by providing security for investors. In the future, there is the risk of inadequate coverage for the level of investment needed. Certifying designs and subjecting prototypes to rigorous testing using marine data, particularly metocean data, will thus play an important role in **allowing underwriters to keep up with technological advances**. Furthermore, predicting remaining useful life under normal operating conditions will **allow operators to better manage their assets and adapt up-keep and maintenance strategies**. Quantitative estimatations of benefits for this example however were not feasible.

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Extend the coastal tourism season			
Coastal cleanup and awareness raising to attract and develop sustainable eco-tourism	Mitigate the negative impact of increased tourism flow, by raising public awareness. Minimise the impact on marine life and habitats through sustainable eco-tourism solutions.	Meteorological data, data on water quality, coastal erosion. Observation of movement of species, and their habitats. While, on the EU level, there is the Marine Strategy Framework Directive, a coherent framework for the systematic use of this data within the context of coastal development has been lacking.	Due to a lack of specific data on the eco-tourism industry, it is difficult to provide sound estimate for the growth potential of this market in Europe. However specific examples indicate benefits. A US study found the **economic benefits of improving beach water quality could increase the number of visitors by 1,538 visits per year for a total economic impact (local spending) of $US 45,000/year (€35,000/year) (at one beach).**[7] Water quality issues are estimated to impact the tourism industry in Blackpool, UK, **facing losses of £ 1 billion (€1.17 billion) over 15 years**. According to an EU survey in 2010, 500 EU beaches did not reach minimum quality standards. There is potential therefore that cleanup may **result in avoided losses of up to €585 billion over 15 years**.
Artificial reefs: surf and diving opportunities	Artificial reefs have the potential to increase sustainable coastal tourism through surf and diving revenues, but also protect marine species and therefore create potential dive and game fishing sites.	Bathymetry and topography, marine currents and meteorology, quality of water and salinity: to optimise location, material used and reduce impacts on environment	US studies have found that depending on its size and the method used, creating an artificial reef can cost from $US 46,000 to $US 2 million (€35,000 to €1.5 million).[8] In Florida, where there are some **2700 artificial reefs**, a study found that **non-residents and visitors annually spent $US 1.7 billion (€1.3 billion) on fishing and diving activities associated with artificial reefs**.[9] Similar potential may be possible for the EU.
Protection against coast erosion	Better coastal protection will save on structural damage and insurance costs, as well as enable sustainable management of tourism growth, minimising impact.	Data on past observations of meteorological events, current water flows, winds, water temperature, topography, bathymetry and human activity impacts to prepare an appropriate response to erosion.	Protecting against coastal erosion can provide very direct economic benefits, including lowering insurance premiums, saving productive coastal land and protecting tourist destinations that provide a crucial injection of revenue for many coastal economies. Beyond these direct benefits, there are also less tangible benefits. For example, a Portuguese study by Alves *et al*, using the Benefit Transfer approach, found that the **total value of coastal ecosystem services in central Portugal amounted to € 193 million annually and that expected ecosystem service value losses amount to € 45 million by 2058**.[10]

[7] http://surfeconomics.blogspot.co.uk/2009/11/cost-of-poor-water-quality-at-surfrider.html
[8] Pendleton 'Understanding the Potential Economic Impacts of Sinking Ships for SCUBA Recreation'. 2005.
[9] 'Adams, Lindberg & Stevely 'The Economic Benefits Associated with Florida's Artificial Reefs'. 2006, 2011 (revised)
[10] Alves, Roebling, Pinto & Batista 'Valuing Ecosystem Service Losses from Coastal Erosion Using a Benefits Transfer Approach: A Case Study for the Central Portuguese Coast'. Journal of Coastal Research n 56, 2009.

Discovery of new bio-economy products			
Development of seaweed based products	Localising natural resources and a more stable cultivation process of algae will maximise the benefits for potential growth markets.	The potential economic return of cultivated algae is unknown, as there is a lack of long term trial data. Data on the location and availability of natural stocks based on prediction models and observations.	Given the two main potential markets that are bioenergy and biomaterials, the economic benefits of products based on seaweed are potentially very high. Nonetheless, it is difficult to estimate the economic benefit for potential uses at an early stage of development. As an example, **Irish seaweed production and processing sector will be worth € 30 million per annum by 2020** (the sector is currently worth € 18 million per annum).[11] In order to reach this target, there is a need to capitalise on the existing wild resources and augment supplies of high value seaweeds. Similar growth projects may be possible for other Member States if better data is available to develop the sector.
Innovation aquatic pharmacy products	Biotechnology companies looking for pharmaceuticals / enzymes to catalyse industrial processes need to know where to look. Data to locate these organisms has the potential to unlock the economic potential associated with new discoveries.	Bioprospecting, greater knowledge of sediments, habitats and sea-floor topography to better target scientific exploration. Extensive taxonomy of marine organism in order to create biobanks: type, focus and taxonomy of organisms, amount available, format.	The global market for marine-derived drugs was $US 4.8 billion in 2011 and is expected to be $US 5.3 billion in 2012. According to BCC Research, this **global market is forecasted to reach $US 8.6 billion (€6.7 billion) in 2016** at a compound annual growth rate of 12.5 % for the five-year period of 2011 to 2016. [12] Furthermore, 2011 research by BCC Research found mollusc to be the fastest growing market for marine-derived drugs, **expected to grow from $US 69.4 million in 2011 to $US 490.1 million (€382 million) by 2016** at a CAGR of 47.8%.[13]

[11] A Market Analysis towards the further development of Seaweed Aquaculture in Ireland, Máirtín Walsh, Lucy Watson, BIM
[12] "Global Markets for Marine – Derived Pharmaceuticals" cited in Market Research Reports and Technical Publications Product Catalog December 2012, http://www.bccresearch.com/report/marine-derived-pharma-markets-phm101a.html
[13] "Global Markets for Marine – Derived Pharmaceuticals" cited in Market Research Reports and Technical Publications Product Catalog December 2012, http://www.bccresearch.com/report/marine-derived-pharma-markets-phm101a.html

Protecting Biodiversity for Tomorrow's Blue Economy	Biodiversity is crucial for the health of ecosystems. Furthermore the genetic diversity of undiscovered marine resources offers an inestimable stream of future innovation for the blue biotechnology sector. In order to better manage ecological security and ensure a flow of future innovation, researchers and policy makers must first be able to better understand and measure biodiversity.	Biodiversity data comes from a wide spectrum of sources and goes beyond populations of specific species. It also requires data to feed indicators on phenomena such as pollution, non-native species, eutrophication, etc… Developing new tools and methods to measure the health of ecosystems and new modes of cooperation in order to improve the cost-effectiveness of gathering and analysing environmental data are key challenges for better policy making in Europe. Understanding and internalising the economic 'cost' of losing biodiversity will also act as a driver for better decision making.	While assigning economic value to ecosystem and biodiversity may seem reductive, the exercise can provide a sense of what Europeans stands to lose from future changes in biodiversity, although it glosses over ethical considerations such as the intrinsic or 'non-use' value of natural resources. Undiscovered species under threat of extinction, while they may have **little economic 'use value' can hold astronomical 'option value'** in that they may hold keys to future scientific advancement. For example, **significant value ($US 230–330 million[14] (€180 to 260 million)) has been attributed to genetic information gained from preventing land conversion** in Jalisco, Mexico, in an area containing a wild grass, teosinte (Euchlaena mexicana), that can be used to develop viral-resistant strains of perennial corn.
Other cases			
Sea-bed mining, mineral resources	By improving our understanding of the seafloor ecosystem, in terms of vulnerability, resilience and functioning of marine biodiversity, this can reduce the risks of seabed mining and potentially lead to development of commercial deep sea mining sector.	Further basic research on 'what lives where' and what affects the patchy nature of deep sea biotic distributions is needed to advance our understanding of this unexplored marine diversity and its associated biogeographic classifications. Data needs include seabed substrata, deep sea life, currents, etc to plan extraction, design instruments and understand behaviour of lifeforms.	Without better marine knowledge, the risks and costs of deep sea mining far outweigh the potential economic benefits. An example of the potential economic benefits of deep sea mining is the Solwara 1 deep-sea mining project in Papua New Guinea. This project was due to commence in 2014, and it is estimated that it would bring in more than **$US 140 million (€109 million) to Papua New Guinea's economy in its first two years of operation and claim that about 70 per cent of the project's staff would come from the country**.[15] However there are concerns it will result in the destruction of a still unexplored ecosystem. These concerns need to be better understood, in order to weight up the costs against the potential benefits.

[14] Fisher, A. C. & Hanemann, W. M. Option value and the extinction of species. Adv. Appl. Micro-Econ.4, 169–190 (1986)
[15] Sarmiento, P. "Should deep-sea mining go ahead in Papua New Guinea?", January 2013

Data to optimise offshore wind energy yield	Current knowledge gaps lead to underestimation of energy yield. Better predicting energy yield can assist in improving site selection and therefore potential productivity of industry.	Information required includes wind data, air intensity, turbulence intensity, topography, in order to provide accurate wind energy estimations.	A better assessment of energy yield will have a **positive impact on the investment case, resulting in more confidence in project financing, reduction in cost through optimisation of site selection, and increase in potential production**. However quantifying the benefits are very difficult to estimate, given a lack of quantitative studies in this area. This said, it has been recognised that **innovation opportunities over the next 10 years can bring down the deployment costs of offshore wind by up to ~25%, with further savings after 2020 likely to bring down costs even further (up to circa 60% by 2050)**.[16]
Optimisation of turbine foundation design	Foundation costs can represent up to 40% of wind capital expenditure on offshore wind. The sharing of data from experimental offshore installations can help researchers validate new types of more cost-effective foundations.	Measured data from experimental offshore installations (different structures and technologies) to validate existing models. Quality time series on sea-state parameters, currents, sea surface elevation, also soil characteristics.	Cost effective design optimisation of turbine foundation means that installations can be installed more economically. An example in the UK suggested that **minor design changes could lead to significant savings in construction schedule and costs**. The designers decided to make minor modifications to the monopile by welding a flange to which the wind tower could be bolted thereby getting rid of the transition piece and the expensive grouting used to connect it to the monopile altogether.[17] However for this given example, quantitative estimates of the benefits in terms of cost and time savings have not been established.

[16] Technology Innovation Needs Assessment (TINA), Offshore Wind Power Summary Report, Innovation Coordination Group, 2012
[17] http://cdn.intechopen.com/pdfs/14804/InTech-Selection_design_and_construction_of_offshore_wind_turbine_foundations.pdf

Table 0-6 Case study examples of benefits resulting from a reduction in uncertainty

Title	Hypothesis	Data needs	Economic benefits
Protection of cables for offshore wind	Optimisation of cable protection will reduce risk of damage in long term, reduce costs in installation phase, as well as costs for ongoing maintenance.	Uncertainties would be reduced through better sea-bed data: seabed mapping systems that accurately chart depth, topography, slope angles and seabed type.	Economic damage to cables can potentially be significant as the repair of broken cables is very expensive. Even small areas of mischaracterized seabed can cause significant downtime to repair a damaged cable. The mean time to repair is months for conventional submarine power cables and longer repairs can be expected as cables are laid at deeper and deeper depths. As an illustrative example, in April 2012 the NorNed 700 MW direct-current cable connecting the Netherlands and Norwegian electricity systems failed, **halting production for 10 weeks, and resulting in lost earnings of around € 145 million**. The benefits of protective systems are confirmed through the fact that while cables make up 8% of investment, 80% of insurance enquiries refer to these systems. In an attempt to extrapolate on this example, we need to determine the number of cable failures annually and ideally the average duration of interruption. A study found that there is 1 cable failure per 1,000km of cable per year.[18] To determine the cumulative length of cable for offshore wind structures Europe, we take the total number of turbines (1,662) and multiply this by the average distance to shore of 29km (29km of cable exposed to risk of cable failure), resulting in a total of 48,198km of cable at risk of failure. Taking our previous assumption, if 1 cable failure occurs per 1,000km of cable per annum, there would be **48 failures per year, which would result in lost earnings, based on a 10 week break in production, of € 6.9 billion.**
Site accessibility to optimise operations and maintenance for offshore wind	Better accessibility results in reduced downtime losses, avoidance of energy production losses, and potentially prevention of costly repairs.	Actual weather conditions, forecasts of wind and sea state to optimise O&M. Data on wind turbine failure rate, data from access systems, supply boats, and crane barges, as inputs into models.	**An uplift in the wave height at which maintenance is possible could improve turbine availability from 80% to 90%, translating to a potential saving of £ 245,000 (or € 285,000) per 5MW turbine per year.** If this were applied to 50% of the 1,662 turbines installed and grid connected, totalling 4,995 MW in 55 wind farms in ten European countries at the end of 2012,[19] this would result in **combined savings of € 236.8 million per annum**.

[18] http://ocw.tudelft.nl//fileadmin/ocw/courses/OffshoreWindFarmEnergy/res00047/Module_9_wind_farm_aspects.pdf

[19] EWEA, European Offshore Statistics 2012, http://www.ewea.org/fileadmin/files/library/publications/statistics/European_offshore_statistics_2012.pdf

Hydrographic data to assist optimising ship navigation routes	Improved hydrographic data coverage will positively benefit navigation safety and protection of the marine environment, among many other benefits.	Lack of up-to-date charting and hydrographic survey data. In Europe, the most significant gaps are in the Mediterranean and Black Seas High resolution access to seafloor morphology and texture, covering topography, bathymetry, geology	Improved charts enable **cost reductions through faster transit for ships, more direct routes, reduced insurance costs, and avoidance of maritime accidents**. As an illustration, the National Oceanographic and Atmospheric Administration (NOAA) reported that **one additional foot of draught may account for between $US 36,000 and $US 288,000 (between €28,000 and €225,000) of increased profit per transit** into Tampa, Florida, USA.[20] Furthermore, the **economic benefits and savings associated with preventing marine accidents through more adequate surveys are significant**. For the example of the Sea Diamond, the bill footed by the owner company **cost $US 6 million (€4.7 million)**, while a **floating barrier that has been placed in the area of the wreck is monitored daily by a pollution-control vessel staffed by specialised personnel**, again at the shipowning company's expense.

[20] National Oceanic and Atmospheric Administration (NOAA), (2000), Technical Report NOS COOPS 031, National Physical Oceanographic Real-Time Systems (PORTS) Management Report. Silver Spring, Md.

Options for governance of European marine observation and data networks

The section on governance aims to assess the organisational and administrative aspects of running a secretariat to govern the "European marine observation and data networks".

It is mentioned in ToR that "An ideal secretariat would (1) deliver an annual work programme to achieve a set of objectives.(2) negotiate approval of the work programme with a "governing board" (3) implement the work programme in a way that is compatible with the EU's Financial Regulation."

The focus of the governance assessment has been on the qualitative analysis of the identified secretariat options in an effort to uncover the advantages and disadvantages of each one according to a number of parameters. A limited quantitative assessment was undertaken due the limited size and available operational budget of the secretariat.

In summary the following findings and recommendations on EMODNet project management can be drawn:

› **Full internalisation.** An internalisation of the secretariat would most likely centre on DG MARE. While this option would have benefits through direct control, planning and synergies, it would in most likelihood impose additional administrative and operational burdens on DG MARE;

› **Allocation of the secretarial tasks to an Executive Agency**. The role of Executive Agencies is clearly defined to manage programmes on behalf of the Commission and has proven so. EACI could be the more relevant agency to manage the secretariat based on the project management cycle and the themes of programmes dealt with.

› **Allocation of the secretariat tasks to a Regulatory Agency.** A Regulatory Agency could manage the secretariat. The more relevant agencies would be EEA or EMSA based on thematic and operational characteristics. However the mandates and tasks of Regulatory Agencies go beyond what is needed to run the secretariat and may prove to be more cumbersome in administrative terms. The Executive Agency model is more aligned to the direct needs of the secretariat and the European Commission.

› **Other options (Joint Initiatives)**. Of the other options examined the Joint Initiatives appear the more appropriate model. Especially Copernicus was an example of a relevant organisation to manage not only the secretariat but the programme in terms of thematic expertise and content of tasks. There seems to be possibilities of achieving synergies between EMODNet and the maritime part of Copernicus as the programme beneficiary group may to a large part be identical.

› **Private entities.** It was found that the value added of EMODNet is in providing the data (gathering, monitoring and basic processing) without restrictions and at marginal costs (as a public good). This and operational limitation in the financial regulation limits the attractiveness of having a private entity running the secretariat. It is envisaged that private entities can utilise the data provided by EMODNet and benefit from further processing it.

Overall, based on the relative limited size of the secretariat it is recommended that it should be placed in close proximity to the parent DG, in this case DG MARE, either internally in the DG or in an Executive Agency. One alternative option would be to assess if there are synergies with the maritime part of Copernicus and if merging the programme into Copernicus could benefit the implementation of both programmes.